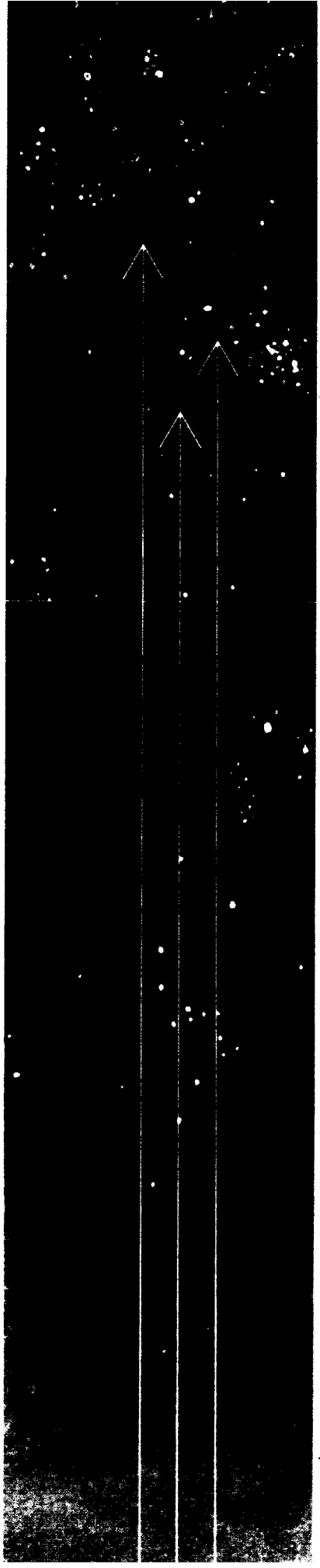

GLOSSARY OF TERMS USED IN THE EXPLORATION OF SPACE

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GLOSSARY OF TERMS USED IN THE EXPLORATION OF SPACE

A

Aberration—1. In astronomy, the apparent displacement of the position of a celestial body in the direction of motion of the observer, caused by the combination of the velocity of the observer and the velocity of light. 2. In optics, a deviation from perfect imagery as, for example, distortion.

Ablating Material—A material designed to dissipate heat by vaporizing or melting.

Ablating materials are used on the surfaces of some reentry vehicles. Ablating materials absorbs heat by increase in temperature and change in chemical or physical state. The heat is carried away from the surface by a loss of mass (liquid or vapor). The departing mass also blocks part of the convective heat transfer to the remaining material.

Ablation—The removal of surface material from a body by vaporization, melting, or other process; specifically the intentional removal of material from a nosecone or spacecraft during high-speed movement through a planetary atmosphere to provide thermal protection to the underlying structure. See **Ablating Material.**

Abort—To cancel or cut short a flight.

Absolute Altitude—Altitude above the actual surface of a planet or natural satellite, either land or water.

Absolute Pressure—In engineering literature, a term used to indicate pressure above the absolute zero value corresponding to empty space as distinguished from "gage pressure".

In vacuum technology, "pressure" always corresponds to absolute pressure, and therefore the term "absolute pressure" is not required.

Absolute Temperature—Temperature value relative to absolute zero.

Absolute Zero—The theoretical temperature at which all molecular motion ceases.

"Absolute zero" may be interpreted as the temperature at which the volume of a perfect gas vanishes, or more generally as the temperature of the cold source which would render a Carnot cycle 100 percent efficient. The value of absolute zero is now estimated to be −273.16° Celsius (Centigrade), −459.69° Fahrenheit, 0° Rankine.

Absorption—The process in which incident electromagnetic radiation is retained by a substance. A further process always results from absorption: that is, the irreversible conversion of the absorbed radiation into some other form of energy within and according to the nature of the absorbing medium. The absorbing medium itself may emit radiation, but only after an energy conversion has occurred.

Acceleration—The rate of change of velocity.

Decrease in velocity is sometimes called "negative acceleration."

Accelerometer—An instrument which measures acceleration or gravitational forces capable of imparting acceleration.

An accelerometer usually uses a concentrated mass (seismic mass) which resists movement because of its inertia. The displacement of the seismic mass relative to its supporting frame or container is used as a measure of acceleration.

Acceptance—The act of an authorized representative of the Government by which the Government assents to ownership by it of existing and identified articles, or approves specific services rendered as partial or complete performance of the contract.

Access Time—Of a computer, the time required under specified conditions to transfer information to or from storage, including the time required to communicate with the storage location.

Accumulator—A device or apparatus that accumulates or stores up, as: 1. A contrivance in a hydraulic system that stores fluid under pressure. 2. A device sometimes incorporated in the fuel system of a gas-turbine engine to store up and release fuel under pressure as an aid in starting.

Acoustic Excitation—Process of inducing vibration in a structure by exposure to sound waves.

Acoustic Generator—Transducer which converts electric, mechanical, or other forms of energy into sound.

Acoustic Velocity—The speed of propagation of sound waves. Also called "speed of sound."

Acquisition—1. The process of locating the orbit of a satellite or trajectory of a space probe so that tracking or telemetry data can be gathered. 2. The process of pointing an antenna or telescope so that it is properly oriented to allow gathering of tracking or telemetry data from a satellite or space probe.

Actinic—Pertaining to electromagnetic radiation capable of initiating photochemical reactions, as in photography or the fading of pigments.

Because of the particularly strong action of ultraviolet radiation on photochemical processes, the term has come to be almost synonymous with ultraviolet, as in "actinic rays".

Active—Transmitting a signal, as "active satellite," in contrast to "passive".

Adiabatic—Without gain or loss of heat.

Adsorption—The adhesion of a thin film of liquid or gas to the surface of a solid substance. The solid does not combine chemically with the adsorbed substance.

Aerobiology—The study of the distribution of living organisms freely suspended in the atmosphere.

Aeroduct—A ramjet type of engine designed to scoop up ions and electrons freely available in the outer reaches of the atmosphere or in the atmospheres of other spatial bodies, and by a chemical process within the duct of this engine, expel particles derived from the ions and electrons as a propulsive jet stream.

Aerodynamic Heating—The heating of a body produced by passage of air or other gases over the body, significant chiefly at high speeds, caused by friction and by compression processes.

Aerodynamics—The science that treats of the motion of air and other gaseous fluids, and of the forces acting on bodies when the bodies move through such fluids, or when such fluids move against or around the bodies, as "his research in aerodynamics".

Aerodynamic Vehicle—A device, such as an airplane, glider, etc., capable of flight only within a sensible atmosphere and relying on aerodynamic forces to maintain flight.

This term is used when the context calls for discrimination from "space vehicle."

Aeroelasticity—The study of the effect of aerodynamic forces on elastic bodies.

Aerolite—A meteorite composed principally of stony material.

Aeronomy—1. The study of the upper regions of the atmosphere where physical and chemical reactions due to solar radiation take place. 2. Science dealing with theories of planetary atmospheres.

Aeropause—A region of indeterminate limits in the upper atmosphere, considered as a boundary or transition region between the denser portion of the atmosphere and space.

From a functional point of view, it is considered to be that region in which the atmosphere is so tenuous as to have a negligible, or almost negligible, effect on men and aircraft, and in which the physiological requirements of man become increasingly important in the design of aircraft and auxiliary equipment.

Aerospace—(From *aero*nautics and *space.*) Of or pertaining to both the earth's atmosphere and space, as in "aerospace industries".

Aerothermodynamic Border—An altitude at about 100 miles, above which the atmosphere is so rarefied that the motion of an object through it at high speeds generates no significant surface heat.

Aerothermodynamics—The study of the aerodynamics and thermodynamic problems connected with aerodynamic heating.

Afterbody—1. A companion body that trails a satellite. 2. A section or piece of a rocket or missile that reenters the atmosphere unprotected behind the nosecone or other body that is protected for reentry. 3. The aft part of a vehicle.

Agena—A second stage rocket which burns liquid oxygen and kerosene, often used with an ATLAS first stage by the United States for satellite and spacecraft launchings.

Agravic—Of or pertaining to a condition of no gravitation. See **Weightlessness.**

Airglow—The quasi-steady radiant emission from the upper atmosphere as distinguished from the sporadic emission of the aurorae.

Airglow is a chemiluminescence due primarily to the emission of the molecules O_2 and N_2, the radical OH, and the atoms O and Na. It may be due to released latent energy from energy stored during daylight. Emissions observed in airglow could arise from 3-body atom collisions forming molecules, from 2-body reactions between atoms and molecules, or from recombination of ions.

Historically "airglow" has referred to visual radiation. Some recent studies use "airglow" to refer to radiation outside the visual range.

Air Shower—A grouping of cosmic-ray particles observed in the atmosphere.

Primary cosmic rays slowed down in the atmosphere emit bremsstrahlung photons of high energy. Each of these photons produces secondary electrons which generate more photons and the process continues until the available energy is absorbed.

Air Sounding—The act of measuring atmospheric phenomena or determining atmospheric conditions at altitude, especially by means of apparatus carried by balloons or rockets.

Albedo—The ratio of the amount of electromagnetic radiation reflected by a body to the amount incident upon it, commonly expressed as a percentage. Compare Bond albedo.

The albedo is to be distinguished from the reflectivity, which refers to one specific wavelength (monochromatic radiation).

Usage varies somewhat with regard to the exact wavelength interval implied in albedo figures; sometimes just the visible portion of the spectrum is considered, sometimes the totality of wavelengths in the solar spectrum.

Alpha Particle—(Symbol $_2He^4$.) A positively charged particle emitted from the nuclei of certain atoms during radioactive disintegration. The alpha particle has an atomic weight of 4 and a positive charge equal in magnitude to 2 electronic charges hence it is essentially a helium nucleus (helium atom stripped of its two planetary electrons).

Alpha particles are important in atmospheric electricity as one of the agents responsible for atmospheric ionization. Minute quantities of radioactive materials such as radium, present in almost all soils and rocks, emit alpha particles and those which enter the surface air layer produce large numbers of ions along their short air paths. Alpha particles of average energy have a range of only a few centimeters in air, so radioactive matter in the earth cannot directly ionize the air above a height of a fraction of a meter. On the other hand, certain radioactive gases, such as radon and thoron, may be carried to heights of several kilometers (after initial formation during a radioactive disintegration of atoms of soil or rock matter) before emitting characteristic alpha particles which can there ionize air in the free atmosphere. The high density of ion pairs produced along the track of an alpha particle favors very rapid recombination (columnar recombination) that greatly reduces the effective ionization produced by these particles.

Ambient—Specifically, pertaining to the environment about a flying aircraft or other body but undisturbed or unaffected by it, as in "ambient air", or "ambient temperature."

Amplidyne—A special type of dc generator used as a power amplifier, in which the output voltage responds to changes in field excitation; used extensively in servo systems.

Analog Computer—A computing machine that works on the principle of measuring, as distinguished from counting, which the input data are made analogous to a measurement continuum, such as voltages, linear lengths, resistances, light intensities, etc., which can be manipulated by the computer.

Analog computers range from the relatively simple devices of the slide rule or airspeed indicator to complicated electrical machines used for solving mathematical problems.

Angel—A radar echo caused by a physical phenomenon not discernible to the eye.

Angstrom (Å)—A unit of length, used chiefly in expressing short wavelengths. Ten billion angstroms equal one meter.

Anomaly—1. In general, a deviation from the norm. 2. In geodesy, a deviation of an observed value from a theoretical value, due to an abnormality in the observed quantity. 3. In celestial mechanics, the angle between the radius vector to an orbiting body from its primary (the focus of the orbital ellipse) and the line of apsides of the orbit, measured to the direction of travel, from the point of closest approach to the primary (perifocus).

The term defined above is usually called "true anomaly", v, to distinguish it from the eccentric anomaly, E, which is measured at the center of the orbital ellipse, or from the mean anomaly, M, which is what the true anomaly would become if the orbiting body had a uniform angular motion.

Anomalistic Period—The interval between two successive perigee passes of a satellite in orbit about a primary. Also called "perigee-to-perigee period."

Anoxia—A complete lack of oxygen available for physiological use within the body. Compare hypoxia.

"Anoxia" is popularly used as a synonym for "hypoxia." This usage should be avoided.

Antigravity—A hypothetical effect that would arise from some energy field's cancellation of the effect of the gravitational field of the earth or other body.

Aphelion—That orbital point farthest from the sun when the sun is the center of attraction. That point nearest the sun is called "perihelion."

The aphelion of the earth is 1.520×10^{13} cm from the sun.

Apogee—In an orbit about the earth, the point at which the satellite is farthest from the earth; the highest altitude reached by a sounding rocket.

Apogee Rocket—A rocket attached to a satellite or spacecraft designed to fire when the craft is at apogee, the point farthest from the earth in orbit. The effect of the apogee rocket is to establish a new orbit farther from the earth or to allow the craft to escape from earth orbit.

Apollo—United States program with the objective of earth-orbiting a space laboratory, launching astronauts to the vicinity of the moon, and landing a man on the moon, and returning him to earth.

Arago Point—One of the three commonly detectable points along the vertical circle through the sun at which the degree of polarization of skylight goes to zero; a neutral point.

The Arago point, so named for its discoverer, is customarily located at about 20° above the antisolar point; but it lies at higher elevations in turbid air. The latter property makes the Arago distance a useful measure of atmospheric turbidity. Measurements of the location of this neutral point are typically more easily carried out than measurements of the Babinet point and the Brewster point, both of which lie so close to the sun (about 20° above and below the sun, respectively) that glare problems become serious.

Arc-Jet Engine—A type of electrical rocket engine in which the propellant gas is heated by passing through an electric arc.

Artifical Antenna—A device which has the equivalent impedance characteristics of an antenna and the necessary power-handling capabilities, but which does not radiate or intercept radiofrequency energy. Also called "dummy antenna."

Artificial Gravity—A simulated gravity established within a space vehicle, as by rotating a cabin about an axis of a spacecraft, the centrifugal force generated being similar to the force of gravity.

Assembly—An element of a component consisting of parts and/or subassemblies which performs functions necessary to the operation of the component as a whole. Examples are: pulsing networks, gyro assembly, oscillator assembly, etc.

Asteriod—One of the many small celestial bodies revolving around the sun, most of the orbits being between those of Mars and Jupiter. Also called "planetoid," "minor planet." See **Planet.**

The term "minor planet" is preferred by many astronomers but "asteriod" continues to be used in astronomical literature, especially attributively, as in "asteriod belt."

Astro—A prefix meaning "star" or "stars" and, by extension, sometimes used as the equivalent of "celestial," as in *astro*nautics.

Astroballistics—The study of the phenomena arising out of the motion of a solid through a gas at speeds high enough to cause ablation; for example, the interaction of a meteoroid with the atmosphere.

Astroballistics uses the data and methods of astronomy, aerodynamics, ballistics, and physical chemistry.

Astrobiology—The study of living organisms on celestial bodies other than the earth.

Astrodynamics—The practical application of celestial mechanics, astroballistics, propulsion theory, and allied fields to the problem of planning and directing the trajectories of space vehicles.

Astronaut—1. A person who occupies a space vehicle. 2. Specifically one of the test pilots selected to participate in Project Mercury, the first United States program for manned space flight.

Astronautics—1. The art, skill, or activity of operating space vehicles. 2. In a broader sense, the science of space flight.

Astronomical Unit (abbr AU)—In the astronomical system of measures, a unit of length usually defined as the distance from the Earth to the Sun, approximately 92,900,000 statute miles or 14,960,000 kilometers. It is more precisely defined as the unit

of distance in terms of which, in Kepler's Third Law, $n^2a^3 = k^2(1 + m)$, the semimajor axis a of an elliptical orbit must be expressed in order that the numerical value of the Gaussian constant, k, may be exactly 0.01720209895 when the unit of time is the ephemeris day.

In astronomical units, the mean distance of the Earth from the Sun, calculated by Kepler's law from the observed mean motion n and adopted mass m, is 1.00000003.

Atlas—An intercontinental ballistic missile which a total THRUST of about 360,000 pounds, frequently used as a first stage for satellite and spacecraft launchings by the United States. It is a liquid-fueled rocket, burning liquid oxygen and kerosene.

Atmosphere—The envelope of air surrounding the earth; also the body of gases surrounding or comprising any planet or other celestial body.

Atmospheric Drag—The retarding force produced on a satellite by its passage through the gas of the high atmosphere. It drops off exponentially with height, and has a small effect on satellites whose PERIGEE is higher than a few hundred kilometers.

Atomic Clock—A precision clock that depends for its operation on an electrical oscillator (as a quartz crystal) regulated by the natural vibration frequencies of an atomic system (as a beam of cesium atoms or ammonia molecules).

Attenuation—In physics, any process in which the flux density (or power, amplitude, intensity, illuminance, etc.) of a "parallel beam" of energy decreases with increasing distance from the energy source. Attenuation is always due to the action of the transmitting medium itself (mainly by absorption and scattering). It should not be applied to the divergence of flux due to distance alone, as described by the inverse-square law. See **Absorption.**

The space rate of attenuation of electromagnetic radiation is described by Bouguer's law.

In meteorological optics, the attenuation of light is customarily termed "extinction." (The latter is sometimes used with regard to any electromagnetic radiation.)

Attitude—The position or orientation of an aircraft, spacecraft, etc., either in motion or at rest, as determined by the relationship between its axes and some reference line or plane such as the horizon.

Auger Shower—A very large cosmic-ray shower. Also called "extensive air-shower."

Augmentation—The apparently larger semi-diameter of a celestial body, when seen against the horizon, as compared to its apparent decrease in size with increased altitude.

The term is used principally in reference to the moon.

Aurora—The sporadic visible emission from the upper atmosphere over middle and high latitudes. Also called "northern lights."

Aurora Australia—The aurora of the Southern Hemisphere. See **Aurora.**

Aurora Borealis—The aurora of northern latitudes. Also called "aurora polaris," "northern lights." See **Aurora.**

Axis—(pl. axes) 1. A straight line about which a body rotates, or around which a plane figure may rotate to produce a solid; a line of symmetry. 2. One of a set of reference lines for certain systems of coordinates.

Azimuth—1. Horizontal direction or bearing. Compare azimuth angle, bearing. 2. In navigation, the horizontal direction of a celestial point from a terrestrial point, expressed as the angular distance from a reference direction, usually measured from 000° at the reference direction clockwise through 360°.

Azusa—A short range tracking system which gives space position and velocity of the object being tracked.

B

Backout—An undoing of things already done during a countdown, usually in reverse order.

Backup—1. An item kept available to replace an item which fails to perform satisfactorily. 2. An item under development intended to perform the same general function performed by another item also under development.

Baker-Nunn Camera—A large camera used in tracking satellites.

Balance—1. The equilibrium attained by an aircraft, rocket, or the like when forces and moments are acting upon it so as to produce steady flight, especially without rotation about its axes; also used with reference to equilibrium about any specified axis, as, an airplane in balance about its longitudinal axis. 2. A weight that counterbalances something, especially, on an aircraft control surface, a weight installed forward of the hinge axis to counterbalance the surface aft of the hinge axis.

Ballistics—The science that deals with the motion, behavior, and effects of projectiles, especially bullets, aerial bombs, rockets, or the like; the science or art of designing and hurling projectiles so as to achieve a desired performance.

Ballistic Trajectory—The trajectory followed by a body being acted upon only by gravitational forces and the resistance of the medium through which it passes.

A rocket without lifting surfaces is in a ballistic trajectory after its engines cease operating.

Balloon-type Rocket—A rocket, such as Atlas, that requires the pressure of its propellants (or other gases) within it to give it structural integrity.

Bar—Unit of pressure equal to 10^6 dyne per cm^2 (10^6 barye) 1000 millibars, 29.53 in. of Hg.

Barye—Something used by British to denote pressure unit of the cgs system of physical units, equal to one dyne per cm^2 (0.001 millibar). See **Microbar.**

Beam—1. A ray or collection of focused rays of radiated energy. See beam width, radiation pattern. 2. = electron beam. 3. A beam (sense 1) of radio waves used as a navigation aid.

Binary Notation—A system of positional notation in which the digits are coefficients of powers of the base 2 in the same way as the digits in the conventional decimal system are coefficients of powers of the base 10.

Binary notation employs only two digits, 1 and 0, therefore is used extensively in computers where the "on" and "off" positions of a switch or storage device can represent the two digits.

In decimal notation $111 = (1 \times 10^2) + (1 \times 10^1) + (1 \times 10^0) = 100 + 10 + 1 =$ *one hundred and eleven.*

In binary notation $111 = (1 \times 2^2) + (1 \times 2^1) \times (1 \times 2^0) = 4 + 2 + 1 =$ *seven.*

Bionics—The study of systems which function after the manner of, or in a manner characteristic of, or resembling, living systems.

Bipropellant—A rocket propellant consisting of two unmixed or uncombined chemicals (fuel and oxidizer) fed to the combustion chamber separately.

Bird—A colloquial term for a rocket, satellite, or spacecraft.

Bit—(From *bi*nary digi*t*.) A unit of information.

Black Body (abbr b).—1. A hypothetical "body" which absorbs all of the electromagnetic radiation striking it; that is, one which neither reflects nor transmits any of the incident radiation.

No actual substance behaves as a true black body, although platinum black and other soots rather closely approximate this ideal. However, one does speak of a black body with respect to a particular wavelength interval. This concept is fundamental to all of the radiation laws, and is to be compared with the similarly idealized concepts of the white body and the gray body. In accordance with Kirchoff's law, a black body not only absorbs all wavelengths, but emits at all wavelengths and does so with maximum possible intensity for any given temperature.

Black Box—Colloquially, any unit, usually an electronic device such as an amplifier, which can be mounted in a rocket, spacecraft, or the like as a single package. See **Component.**

Blackout—1. A fadeout of radio communications due to environmental factors such as ionospheric disturbances, or a plasma sheath surrounding a reentry vehicle. 2. A condition in which vision is temporarily obscured by a blackness, accompanied by a dullness of certain of the other senses, brought on by decreased blood pressure in the head and a consequent lack of oxygen, as may occur in pulling out of a high-speed dive in an airplane.

Blockhouse—(Also written "block house"). A reinforced concrete structure, often built underground or partly underground, and sometimes dome-shaped, to provide protection against blast, heat, or explosion during rocket launchings or related activities; specifically, such a structure at a launch site that houses electronic control instruments used in launching a rocket.

Boilerplate—As in "boilerplate caspule," a metal copy of the flight model, the structure or components of which are heavier than the flight model.

Boiloff—The vaporization of a cold propellant such as liquid oxygen or liquid hydrogen, as the temperature of the propellant mass rises as in the tank of a rocket being readied for launch.

"Bola" Concept—Concept of a manned nuclear vehicle in which a long cable separates the manned platform from the reactor power system, with consequent reduction of biological hazard and the need for heavy shielding.

Boltzmann's Constant—The ratio of the universal gas constant to Avogadro's number; equal to 1.3804 x 10^{-16} ergs per degree K. Sometimes called "gas constant per molecule," "Boltzmann's universal conversion factor."

Bond Albedo—The ratio of the amount of light reflected from a sphere exposed to parallel light to the amount of light incident upon it. Sometimes shortened to "albedo."

The Bond albedo is used in planetary astronomy.

Booster—Short for "booster engine" or "booster rocket."

Booster Engine—An engine, especially a booster rocket, that adds its thrust to the sustainer engine.

Booster Rocket—1. A rocket engine, either solid or liquid fuel, that assists the normal propulsive system or sustainer engine of a rocket or aeronautical vehicle in some phase of its flight. 2. A rocket used to set a missile vehicle in motion before another engine takes over.

In sense 2 the term "launch vehicle" is more commonly used.

Boostglide Vehicle—A vehicle (half aircraft, half spacecraft) designed to fly to the limits of the sensible atmosphere, then be boosted by rockets into the space above, returning to earth by gliding under aerodynamic control.

Bouguer's Law—A relationship describing the rate of decrease of a flux density of a plane-parallel beam of monochromatic radiation as it penetrates a medium which both scatters and absorbs at that wavelength.

Braking Ellipses—A series of ellipses, decreasing in size due to aerodynamic drag, followed by a spacecraft in entering a planetary atmosphere.

In theory, this maneuver will allow a spacecraft to dissipate energy through aerodynamic heating without burning up.

Breakoff Phenomenon—The feeling which sometimes occurs during high-altitude flight of being totally separated and detached from the earth and human society. Also called the "breakaway phenomenon."

Bremsstrahlung Effect—The emission of electromagnetic radiation as a consequence of the acceleration of charged elementary particles, such as electrons, under the influence of the attractive or repulsive force—fields of atomic nuclei near which the ambient, charged particle moves.

In cosmic-ray shower production, bremsstrahlung (in German, "braking radiation") effects give rise to emission of gamma rays as electrons encounter atmospheric nuclei. The emission of radiation in the bremsstrahlung effect is merely one instance of the general rule that electromagnetic radiation is emitted only when electric charges undergo acceleration.

British Thermal Unit (Btu)—The amount of heat required to raise 1 pound of water at 60°F, 1°F. General usage makes 1 Btu equal 252 calories.

Buffer—In computers: 1. An isolating circuit used to avoid reaction of a driven circuit on the corresponding driving circuit. 2. A storage device used to compensate for a difference in rate of flow of information or time on occurrence of events when transmitting information from one device to another.

Burn—A period during which a rocket engine is firing, as in "second burn" the second period during a flight in which the engine is firing.

Burning Rate (abbr r).—Velocity at which a solid propellant in a rocket is consumed, measured in a direction normal to the propellant surface and is usually expressed in inches per second.

Burnout—1. An act or instance of the end of fuel and oxidizer burning in a rocket; the time at which this burnout occurs. Compare cutoff. 2. An act or instance of something burning out or of overheating; specifically, an act or instance of a rocket combustion chamber, nozzle, or other part overheating so as to result in damage or destruction.

Burst—1. A single pulse of radio energy; specifically such a pulse at radar frequencies. 2. Solar radio burst. 3. Cosmic ray burst.

C

Calorie—Originally amount of heat required to raise temperature of one gram of water through one degree centigrade (the gram-calorie), but a more precise expression is that a 15° gram-calorie (cal $_{15}$) is the amount of heat required to raise the temperature of one gram of water from 14.5°C to 15.5°C and is equal to 4.1855 joules.

Capacity—In computer operations: 1. The largest quantity which can be stored, processed, or transferred. 2. The largest number of digits or characters which may be regularly processed. 3. The upper and lower limits of the quantities which may be processed.

Capsule—1. A boxlike component or unit, often sealed. 2. A small, sealed, pressurized cabin with an internal environment which will support life in a man or animal during extremely high altitude flight, space flight, or emergency escape.

The term, "spacecraft," is preferred to capsule for any man-carrying vehicle.

Cascade Shower—A group occurrence of cosmic rays. Also called "air shower."

Cavitation—The turbulent formation of bubbles in a fluid, occurring whenever the static pressure at any point in the fluid flow becomes less than the fluid vapor pressure.

Celestial Mechanics—The study of the theory of the motions of celestial bodies under the influence of gravitational fields.

Celestial Sphere—An imaginary sphere of infinite radius concentric with the earth, on which all celestial bodies except the earth are assumed to be projected.

Centrifuge—A mechanical device which applies centifugal force to the test specimen by means of a long rotating arm to simulate very closely the prolonged accelerations encountered in high-performance aircraft, rockets, and spacecraft.

The simulated acceleration of centrifugal force produced is proportional to the distance from the center of rotation and the square of the rotational velocity.

Characteristic—Any dimensional, visual, functional, mechanical, electrical, chemical, physical, or material feature or property; and any process-control element which describes and establishes the design, fabrication, and operating requirements of an article.

Chase Pilot—A pilot who flies in an escort apirlane advising a pilot who is making a check, training, or research flight in another craft.

Checkout—1. A sequence of actions taken to test or examine a thing as to its readiness for incorporation into a new phase of use, or for the performance of its intended function. 2. The sequence of steps taken to familiarize a person with the operation of an airplane or other piece of equipment.

In sense 1, a checkout is usually taken at a transition point between one phase of action and another. To shorten the time of checkout, automation is frequently employed.

Cheese Antenna—A cylindrical parabolic reflector enclosed by two plates perpendicular to the cylinder, so spaced as to permit the propagation of more than one mode in the desired direction of polarization. It is fed on the focal line.

Chemical Fuel—1. A fuel that depends upon an oxidizer for combustion or for development of thrust, such as liquid or solid rocket fuel or internal-combustion-engine fuel; distinguished from nuclear fuel. 2. A fuel that uses special chemicals, such as a boron-based fuel.

Chemical Rocket—A rocket using chemical fuel, fuel which requires an oxidizer for combustion, such as liquid or solid rocket fuel.

Chemosphere—The vaguely defined region of the upper atmosphere in which photochemical reactions take place. It is generally considered to include the stratosphere (or the top thereof) and the mesosphere, and sometimes the lower part of the thermosphere.

This entire region is the seat of a number of important photochemical reactions involving atomic oxygen 0, molecular oxygen O_2, ozone O_3, hydroxyl OH, nitrogen N_2, sodium Na, and other constituents to a lesser degree.

Chromosphere—A thin layer of relatively transparent gases above the PHOTOSPHERE of the sun. It is most easily observed during a total solar eclipse.

Chokes—Pain and irritation in the chest and throat as a result of reduced ambient pressure.

Chugging—A form of combustion instability, especially in a liquid-propellant rocket engine, characterized

by a pulsing operation at a fairly low frequency, sometimes defined as occurring between particular frequency limits; the noise made in this kind of combustion. Also called "chuffing."

Cislunar—(Latin cis "on this side".) Of or pertaining to phenomena, projects, or activity in the space between the earth and moon, or between the earth and the moon's orbit.

Closed Ecological System—A system that provides for the maintenance of life in an isolated living chamber such as a spacecraft cabin by means of a cycle wherein exhaled carbon dioxide, urine, and other waste matter are converted chemically or by photosynthesis into oxygen, water, and food.

Coherent—Of electromagnetic radiation, being in phase so that waves at various points in space act in unison.

Cold-flow Test—A test of a liquid rocket without firing it to check or verify the efficiency of a propulsion subsystem, providing for the conditioning and flow of propellants (including tank pressurization, propellant loading, and propellant feeding.)

Comet—A luminous member of the solar system composed of a head or coma at the center of which a presumably solid nucleus is sometimes situated, and often with a spectacular gaseous tail extending a great distance from the head.

Command—A signal which initiates or triggers an action in the device which receives the signal.

The orbits of comets are highly elliptical.

Communications Satellite—A satellite designed to reflect or relay radio or other communications waves.

Companion Body—A nose cone, last-stage rocket, or other body that orbits along with an earth satellite.

Complex—Entire area of launch site facilities. This includes blockhouse, launch pad, gantry, etc. Also referred to as a "launch complex."

Component—A self-contained combination of parts and/or assemblies within a subsystem performing a function necessary to the subsystem's operation. Examples are: receivers, transmitters, modulators, etc.

Composite Materials—Structural materials of metal alloys or plastics with built-in strengthening agents which may be in the form of filaments, foils, or flakes of a strong material.

Composite Propellant—A solid rocket propellant consisting of a fuel and an oxidizer.

Computer—A machine for carrying out calculations and performing specified transformations on information.

Configuration—A particular type of a specified aircraft, rocket, etc., which differs from others of the same model by virtue of the arrangement of its components or by the addition or omission of auxiliary equipment as "long-range configuration," "cargo configuration."

Conic—A conic section.

Conic Section—A curve formed by the intersection of a plane and a right circular cone. Usually called "conic."

The conic sections are the ellipse, the parabola, and the hyperbola; curves that are used to describe the paths of bodies moving in space.

The circle is a special case of the ellipse, an ellipse with an eccentricity of zero.

Console—An array of controls and indicators for the monitoring and control of a particular sequence of actions, as in the checkout of a rocket, a countdown action, or a launch procedure.

A console is usually designed around desklike arrays. It permits the operator to monitor and control different activating instruments, data recording instruments, or event sequencers.

Constellation—Originally a conspicuous configuration of stars; now a region of the celestial sphere marked by arbitrary boundary lines.

Contractor—The individual(s) or concern(s) who enter(s) into a prime contract with the Government.

Contravane—A vane that reverses or neutralizes a rotation of a flow. Also called a "countervane."

Control—Specifically, to direct the movements of an aircraft, rocket, or spacecraft with particular reference to changes in altitude and speed. Contrast guidance.

Control Rocket—A vernier engine, retrorocket, or other such rocket, used to guide or make small changes in the velocity of a rocket, spacecraft, or the like.

Coriolis Acceleration—An acceleration of a particle moving in a (moving) relative coordinate system. The total acceleration of the particle, as measured in an internal coordinate system, may be expressed as the sum of the acceleration within the relative system, the acceleration of the relative system itself, and the coriolis acceleration.

In the case of the earth, moving with angular velocity Ω, a particle moving relative to the earth with velocity V has the coriolis acceleration $2\Omega \times V$. If Newton's laws are to be applied in the relative system, the coriolis acceleration and the acceleration of the relative system must be treated as forces. See **Gravity.**

Corona—1. The faintly luminous outer envelope of the sun. Also called "solar corona."

The corona can be observed at the earth's surface only at solar eclipse or with the coronagraph, a photographic instrument which artificially blocks out the image of the body of the sun.

2. Discharge of electricity which occurs at the surface of a conductor under high voltage. The phenomenon is dependent or ambient pressure of the gas surrounding the conductor.

Since phenomenon is enhanced by reduced pressure, tests must be conducted to verify that no significant corona exists within the spacecraft or its components under anticipated conditions.

Cosmic Dust—Small meteoroids of a size similar to dust.

Cosmic Rays—The aggregate of extremely high energy subatomic particles which bombard the atmosphere from outer space. Cosmic-ray primaries seem to be mostly protons, hydrogen nuclei, but also comprise heavier nuclei. On colliding with atmospheric particles they produce many different kinds of lower-

energy secondary cosmic radiation (see **Cascade Shower.**) Also called "cosmic radiation."

The maximum flux of cosmic rays, both primary and secondary, is at an altitude of 20 km, and below this the absorption of the atmosphere reduces the flux, though the rays are still readily detectable at sea level. Intensity of cosmic ray showers has also been observed to vary with latitude, being more intense at the poles.

COSPAR—Abbreviation for "Committee on Space Research," International Council of Scientific Unions.

Countdown—The time period in which a sequence of events is carried out to launch a rocket; the sequence of events.

Cryogenic Propellant—A rocket fuel, oxidizer, or propulsion fluid which is liquid only at very low temperatures.

Cryogenic Temperature—In general, a temperature range below about —50°C; more particularly, temperatures within a few degrees of absolute zero.

Cutoff—An act or instance of shutting something off; specifically in rocketry, an act of instance of shutting off the propellant flow in a rocket, or of stopping the combustion of the propellant.

D

Data Reduction—Transformation of observed values into useful, ordered, or simplified information.

Debug—1. To isolate and remove malfunctions from a device, or mistakes from a computer routine or program. 2. Specifically, in electronic manufacturing, to operate equipment under specified environmental and test conditions in order to eliminate early failures and to stabilize equipment prior to actual use.

Deceleration—1. The act or process of moving, or of causing to move, with decreasing speed; the state of so moving. 2. A force causing deceleration; also, inertial forces sometimes called "negative acceleration".

Deep Space Net—A combination of three radar and communications stations in the United States, Australia, and South Africa so located as to keep a spacecraft in deep space under observation at all times.

Deep Space Probes—Spacecraft designed for exploring space to the vicinity of the moon and beyond. Deep space probes with specific missions may be referred to as "lunar probe," "Mars probe," "solar probe," etc.

Degradation—Gradual deterioration in performance.

Delay—The time (or equivalent distance) displacement of some characteristic of a wave relative to the same characteristics of a reference wave; that is, the difference in phase between the two waves. Compare lag.

In one-way radio propagation, for instance, the phase delay of the reflected wave over the direct wave is a measure of the extra distance traveled by the reflected wave in reaching the same receiver.

Design Engineering Tests—Environmental tests having the purpose of trying certain design features prior to finalizing design for Design Qualification Tests. For instance the structural model of the spacecraft is subjected to certain environmental exposures or Design Engineering Tests up to design qualification level in order to establish confidence in its structural design.

Design Qualification Tests—Series of environmental and other tests applied to prototype spacecraft, subsystems, components, or experiments to determine if design meets requirements for launch and flight of spacecraft. These tests are planned to subject spacecraft to considerably greater rigors of environment than expected during launch and flight in order to achieve maximum design reliability.

Destruct—The deliberate action of destroying a rocket vehicle after it has been launched, but before it has completed its course.

Destructs are executed when the rocket gets off its plotted course or functions in a way so as to become a hazard.

Deviation—1. In NASA quality control, specific authorization, granted before the fact, to depart from a particular requirement of specifications or related documents. 2. In statistics, the difference between two numbers. Also called "departure." It is commonly applied to the difference of a variable from its mean, or to the difference of an observed value from a theoretical value.

Digital Computer—A computer which operates on the principle of counting as opposed to measuring. See **Analog Computer.**

Diplexer—A device permitting an antenna system to be used simultaneously or separately by two transmitters. Compare with duplexer.

Dish—A parabolic type of radio or radar antenna, roughly the shape of a soup bowl.

Display—The graphic presentation of the output data of a device or system as, for example, a radar scope.

Docking—The process of bringing two spacecraft together while in space.

Doppler Shift—The change in frequency with which energy reaches a receiver when the source of radiation or a reflector of the radiation and the receiver are in motion relative to each other. The Doppler shift is used in many tracking and navigation systems.

Dosimeter—A device, worn by persons working around radioactive material, which indicates the amount (dose) of radiation to which they have been exposed.

Dovap—From Doppler, velocity and position, a tracking system which uses the Doppler shift caused by a target moving relative to a ground transmitter to obtain velocity and position information.

Drogue Parachute—A type of parachute attached to a body, used to slow it down; also called "deceleration parachute," or "drag parachute."

Duplexer—A device which permits a single antenna system to be used for both transmitting and receiving.

"Duplexer" should not be confused with "diplexer," a device permitting an antenna system to be used simultaneously or separately by two transmitters.

Dynamic Pressure—Symbol q. 1. The pressure exerted by a fluid, such as air, by virtue of its motion, equal to one half the fluid density times the fluid velocity square $\frac{1}{2}\rho V^2$.

2. The pressure exerted on a body, by virtue of its motion through a fluid, for example, the pressure exerted on a rocket moving through the atmosphere.

Dyne (abbr d)—That unbalanced force which acting for 1 second on body of 1 gram mass produces a velocity change of 1 cm/sec.

The dyne is the unit of force in the cgs system.

Dysbarism—A general term which includes a complex group of a wide variety of symptoms within the body caused by changes in ambient pressure, exclusive of hypoxia.

E

Ebullism—The formation of bubbles, with particular reference to water vapor bubbles in biological fluids, caused by reduced ambient pressure.

Eccentric—Not having the same center; varying from a circle, as in "eccentric orbit."

Echo—A large plastic balloon with a diameter of 30 meters and weight of 50 kilograms launched on August 12, 1960 by the United States and inflated in orbit. It was launched as a passive communications satellite, to reflect microwaves from a transmitter to a receiver beyond the horizon.

Ecliptic—The apparent annual path of the sun among the stars; the intersection of the plane of the earth's orbit with the celestial sphere.

This is a great circle of the celestial sphere inclined at an angle of about 23°27′ to the celestial equator.

Ecological System—A habitable environment, either created articially, such as in a manned space vehicle, or occurring naturally, such as the enviroment on the surface of the earth, in which man, animals, or other organisms can live in mutual relationship with each other.

Ideally, the environment furnishes the sustenance for life, and the resulting waste products revert or cycle back into the environment to be used again for the continuous support of life.

Effective Atmosphere—1. That part of the atmosphere which effectively influences a particular process or motion, its outer limits varying according to the terms of the process or motion considered.

For example, an earth satellite orbiting at 250 miles altitude remains within the ionosphere, but because the air particles are so rare at this altitude as to cause no appreciable friction or deflection, the satellite may be considered to be outside the effective atmosphere. For movement of air vehicles the effective atmosphere ends at the aerospause (which see.)

Ejection Capsule—1. In an aircraft or manned spacecraft, a detachable compartment serving as a cockpit or cabin, which may be ejected as a unit and parachuted to the ground. 2. In an artificial satellite, probe, or unmanned spacecraft, a boxlike unit usually containing recording instruments or records of observed data, which may be ejected and returned to earth by a parachute or other deceleration device.

Elasticizer—An elastic substance or fuel used in a solid rocket propellant to prevent cracking of the propellant grain and to bind it to the combustion-chamber case.

Electric Propulsion—The generation of thrust for a rocket engine involving acceleration of a propellant by some electrical device such as an arc jet, ion engine, or magnetohydrodynamic accelerator.

Electromagnetic Radiation—Energy propagated through space or through material media in the form of an advancing disturbance in electrical and magnetic fields existing in space or in the media. Also called simply "radiation."

Electron—The subatomic particle that possesses the smallest possible electric charge.

The term "electron" is usually reversed for the orbital particle whereas the term "beta particle" refers to a particle of the same electric charge inside the nucleus of the atom.

Electron Volt—A unit of energy equal to 1.601×10^{-12} erg. It is defined as the kinetic energy gained by an electron which is accelerated through a potential difference of one volt.

Electronic Data Processing—The use of electronic devices and systems in the processing of data so as to interpret the data and put it into usable form.

Ellipse—A plane curve constituting the locus of all points the sum of whose distances from two fixed point called "foci" is constant; an elongated circle.

The orbits of planets, satellites, planetoids, and comets are ellipses; center of attraction is at one focus.

Emissivity—1. The ratio of the emittance of a given surface at a specified wavelength and emitting temperature to the emittance of an ideal black body at the same wavelength and temperature. Sometimes called "emissive power."

The greatest value that an emissivity may have is unity, the least value zero. It is a corollary of Kirchhoff's law that the emissivity of any surface at a specified temperature and wavelength is exactly equal to the absorptivity of that surface at the same temperature and wavelength. The spectral emissivity is for a definite wavelength. The total emissivity is for all wavelengths.

2. (abbr ε) Specifically, the ratio of the flux emitted by a clean, perfectly polished surface of the material to the flux that would have been emitted by a black body at the same temperature.

Environment—An external condition or the sum of such conditions, in which a piece of equipment or a system operates, as in "temperature environment," "vibration environment," or "space environment."

Environments are usually specified by a range of values, and may be either natural or artificial.

Epoch—A particular instant for which certain data are valid.

Escape Velocity—The radial speed which a particle or larger body must attain in order to escape from the gravitational field of a planet or star.

The escape velocity from Earth is approximately 7 miles per sec.; from Mars, 3.2 miles per sec.; and from the Sun, 390 miles per sec. In order for a celestial body to retain an atmosphere for astronomically long periods of time, the mean velocity of the atmospheric molecules must be considerably below the escape velocity.

Exhaust Velocity—The speed at which the exhaust gases are expelled from the nozzle of a rocket. It depends upon the propellant-burning characteristics, and the over-all engine efficiency. Present exhaust velocities using liquid oxygen and kerosene are of the order of 8000 feet per second, about half the theoretical maximum for chemical propellants.

Exobiology—The study of living organisms existing on celestial bodies other than the earth.

Exosphere—The outermost, or topmost portion of the atmosphere.

In the exosphere, the air density is so low that the mean free path of individual particles depends upon their direction with respect to the local vertical, being greatest for upward moving particles. It is only from the exosphere that atmospheric gases can, to any appreciable extent, escape into outer space.

Exotic Fuel—Any fuel considered to be unusual, as a boron-based fuel.

Experiment—A combination of two or more components, including both the sensor and associated electronics, designed for acquisition of data for space research.

Explosive Bolt—A bolt incorporating an explosive which can be detonated on command, thus destroying the bolt. Explosive bolts are used, for example, in separating a satellite from a rocket.

Extraterrestrial—From outside the earth.

Extraterrestrial Radiation—In general, solar radiation received outside the earth's atmosphere.

Eyeballs In, Eyeballs Out—Terminology used by test pilots to describe the acceleration experienced by the person being accelerated. Thus the acceleration experienced by an astronaut at lift-off is "eyeballs in" (positive g in terms of vehicle acceleration), and the acceleration experienced when retrorockets fire is "eyeballs out" (negative g in terms of vehicle acceleration.)

F

Fallaway Section—A section of a rocket vehicle that is cast off and separates from the vehicle during flight, especially such a section that falls back to the earth.

Fatigue—A weakening or deterioration of metal or other material, or of a member, occurring under load, especially under repeated, cyclic, or continued loading.

Field—A region of space at each point of which a given physical quantity has some definite value, thus a "gravitational field," an "electric field," a "magnetic field," etc.

Film Cooling—The cooling of a body or surface, such as the inner surface of a rocket combustion chamber, by maintaining a thin fluid layer over the affected area.

Fixed Satellite—An earth satellite that orbits from west to east at such a speed as to remain constantly over a given place on the earth's equator.

Flare—A bright eruption from the sun's chromosphere.

Flares may appear within minutes and fade within an hour. They cover a wide range of intensity and size, and they tend to occur between sunspots.

Flares are related to radio fadeouts and terrestrial magnetic disturbances.

Flashback—A reversal of flame propagation in a system, counter to the usual flow of the combustible mixture.

Flight—Describes or pertains to travel of spacecraft or stages after liftoff. Thus, in testing, designates spacecraft or element thereof which is to be launched as distinct from structural model and prototype spacecraft which are test specimens only.

Flight Acceptance Tests—The environmental and other tests which spacecraft, subsystems, components, or experiments scheduled for flight must pass before launch. These tests are planned to approximate expected environmental conditions and have the purpose of detecting flaws in material and workmanship.

Flight Unit—Spacecraft which is undergoing or has passed Flight Acceptance Tests (environmental and other tests) which qualify it for launch and space flight.

Flux—The rate of flow of some quantity, often used in reference to the flow of some form of energy. Also called "transport." 2. In nuclear physics generally, the number of radioactive particles per unit volume times their mean velocity.

Flux Density—The flux (rate of flow) of any quantity, usually a form of energy, through a unit area of specified surface. (Note that this is not a volumetric density like radiant density.) Compare luminous density.

The flux density of electromagnetic radiation in general often is preferably specified as "radiant flux density" or "irradiance" in order to distinguish it from the slightest different concept of luminous flux density or illuminance. In radar, flux density commonly is referred to as power density. It is essential

to understand that the flux density of radiation is in no sense a vector quantity, because it is the sum of the flux corresponding to all ray directions incident upon one "side" of the unit area.

Forbush Decrease—The observed decrease in COSMIC RAY activity about a day after a SOLAR FLARE. It is now believed to be caused by a shielding effect produced by magnetic fields contained in the PLASMA cloud emitted from the sun at the time of a flare.

Flying Test Bed—An aircraft, rocket, or other flying vehicle used to carry objects or devices being flight tested.

Free Fall—1. The fall or drop of a body, such as a rocket not guided, nor under thrust, and not retarded by a parachute or other braking device. 2. Weightlessness.

G

g or G—An acceleration equal to the acceleration of gravity, approximately 32.2 feet per second per second at sea level; used as a unit of stress measurement for bodies undergoing acceleration.

GSE—See Ground Support Equipment.

Gamma Ray—A quantum of electromagnetic radiation emitted by a nucleus, each such photon being emitted as the result of a quantum transition between two energy levels of the nucleus. Gamma rays have energies usually between 10 kev and 10 Mev, with correspondingly short wavelengths and high frequencies. Also called "gamma radiation."

Gantry—A frame structure that spans over something, as an elevated platform that runs astride a work area, supported by wheels on each side; specifically, short for "gantry crane" or "gantry scaffold."

Gantry Scaffold—A massive scaffolding structure mounted on a bridge or platform supported by a pair of towers or trestles that normally run back and forth on parallel tracks, used to assemble and service a large rocket on its launching pad. Often shortened to "gantry." Also called "service tower."

This structure is a latticed arrangement of girders, tubing, platforms, cranes, elevators, instruments, wiring, floodlights, cables, and ladders—all used to attend the rocket.

Garbage—Miscellaneous objects in orbit, usually material ejected or broken away from a launch vehicle or satellite.

Gas Cap—The gas immediately in front of a meteoroid or reentry body as it travels through the atmosphere; the leading portion of a meteor. This gas is compressed and adiabatically heated to incandescence.

Generation—In any technical or technological development, as of a missile, jet engine, or the like, a stage or period that is marked by features or performances not marked, or existent, in a previous period of development or production, as in "second generation rocket."

Geo—A prefix meaning "earth," as in "geology," "geophysics."

Most writers used the established terms such as "geology" to refer to the same concept on other bodies of the solar system, as "the geology of Mars," rather than "areology" or "marsology," "geology of the moon," rather than "selenology."

Geocentric—Relative to the earth as a center; measured from the center of the earth.

Geodetic—Pertaining to geodesy, the science which deals with the size and shape of the earth.

Geoid—The equipotential surface which most nearly approximates the mean sea level of the earth.

Geomagnetism—The magnetic phenomena, collectively considered, exhibited by the earth and its atmosphere; by extension, the magnetic phenomena in interplanetary space.

Geophysics—The physics of the earth and its environment, i.e., earth, air, and (by extension), space.

Classically, geophysics is concerned with the nature of physical occurrences at and below the surface of the earth including, therefore, geology, oceanography, geodesy, seismology, hydrology, etc. The trend is to extend the scope of geophysics to include meteorology, geomagnetism, astrophysics, and other sciences concerned with the physical nature of the universe.

Geopotential—The potential energy of a unit mass relative to sea level, numerically equal to the work that would be done in lifting the unit mass from sea level to the height at which the mass is located; commonly expressed in terms of dynamic height or geopotential height.

Geoprobe—A rocket vehicle designed to explore space near the earth at a distance of more than 4,000 miles from the earth's surface. Rocket vehicles operating lower than 4,000 miles are termed "sounding rockets."

Giga—A prefix meaning multiplied by one billion.

Gimbal—1. A device with two mutually perpendicular and intersecting axes of rotation, thus giving free angular movement in two directions, on which an engine or other object may be mounted. 2. In a gyro, a support which provides the spin axis with a degree-of-freedom.

Gnotobiotics—The study of germ-free animals.

Gox—Gaseous oxygen.

Grain—An elongated molding or extrusion of solid propellant for a rocket, regardless of size.

Gravitation—The acceleration produced by the mutual attraction of two masses, directed along the line joining their centers of mass, and of magnitude inversely proportional to the square of the distance between the two centers of mass.

Gravity—The force imparted by the earth to a mass on, or close to the earth. Since the earth is rotating, the force observed as gravity is the resultant of the force of gravitation and the centrifugal force arising from this rotation.

Ground Support Equipment (GSE)—Any ground-based equipment used for launch, checkout, or in-flight support of a space project.

g-suit or G-Suit—A suit that exerts pressure on the abdomen and lower parts of the body to prevent or retard the collection of blood below the chest under positive acceleration.

G-Tolerance—A tolerance in a person or other animal, or in a piece of equipment, to an acceleration of a particular value.

Guidance—The process of directing the movements of an aeronautical vehicle or space vehicle, with particular reference to the selection of a flight path. See **Control.**

In preset guidance a predetermined path is set into the guidance mechanism and not altered, in inertial guidance accelerations are measured and integrated within the craft, in command guidance the craft responds to information received from an outside source. Beam-rider guidance utilizes a beam, terrestrial-reference guidance some influence of the earth, celestial guidance the celestial bodies and particularly the stars, and homing guidance information from the destination. In active homing guidance the information is in response to transmissions from the craft, in semiactive homing guidance the transmissions are from a source other than the craft, and in passive homing guidance natural radiations from the destination are utilized. Midcourse guidance extends from the end of the launching phase to an arbitrary point enroute and terminal guidance extends from this point to the destination.

Gyro—A device which utilizes the angular momentum of a spinning rotor to sense angular motion of its base about one or two axes at right angles to the spin axis. Also called "gyroscope."

H

Hall Effect—The electrical polarization of a horizontal conducting sheet of limited extent, when that sheet moves laterally through a magnetic field having a component vertical to the sheet.

The Hall effect is important in determining the behavior of the electrical currents generated by winds in the lower ionosphere, since these winds advect the ionized layers across the earth's magnetic field and produce a complex electrical current system in the ionosphere. This current system in turn produces small changes in the earth's magnetic field as measured at the surface.

Hardness—Of X-rays and other radiation of high energy, a measure of penetrating power. Radiation which will penetrate a 10-centimeter thickness of lead is considered "hard radiation."

Heat Exchanger—A device for transferring heat from one fluid to another without intermixing the fluids. A regenerator is an example.

Heat Shield—Any device that protects something from heat.

Heat Sink—1. In thermodynamic theory, a means by which heat is stored, or is dissipated or transferred from the system under consideration. 2. A place toward which the heat moves in a system. 3. A material capable of absorbing heat; a device utilizing such a material and used as a thermal protection device on a spacecraft or reentry vehicle. 4. In nuclear propulsion, any thermodynamic device, such as a radiator or condenser, that is designed to absorb the excess heat energy of the working fluid. Also called "heat dump."

Heterosphere—The upper portion of a two-part division of the atmosphere according to the general homogeneity of atmospheric composition; the layer above the homosphere. The heterosphere is characterized by variation in composition, and mean molecular weight of constituent gases.

This region starts at 80 to 100 km above the earth, and therefore closely coincides with the ionosphere and the thermosphere.

Hold—During a countdown: To halt the sequence of events until an impediment has been removed so that the countdown can be resumed, as in "T minus 40 and holding."

Homosphere—The lower portion of a two-part division of the atmosphere according to general homogeneity of atmospheric composition; opposed to the heterosphere. The region in which there is no gross change in atmospheric composition, that is, all of the atmosphere from the earth's surface to about 80 or 100 km.

The homosphere is about equivalent to the neutrosphere, and includes the troposphere, stratosphere, and mesosphere, and also the ozonosphere and at least part of the chemosphere.

Hot Test—A propulsion system test conducted by actually firing the propellants.

Human Engineering—The art or science of designing, building, or equipping mechanical devices or artificial environments to the anthropometric, physiological, or psychological requirements of the men who will use them.

Hunting—Fluctuation about a midpoint due to instability, as oscillations of the needle of an instrument about a median value.

Hydromagnetics—See Magnetohydrodynamics.

Hypersonic—1. Pertaining to hypersonic flow. 2. Pertaining to speeds of Mach 5 or greater.

Hypersonic Flow—In aerodynamics, flow of a fluid over a body at speeds much greater than the speed of sound and in which the shock waves start at a finite distance from the surface of the body.

Hypoxia—Oxygen deficiency in the blood, cells, or tissues of the body in such degree as to cause psychological and physiological disturbances.

Hypoxia may result from a scarcity of oxygen in the air being breathed, or from an inability of the body tissues to absorb oxygen under conditions of low ambient pressure. In the latter case, water vapors from body fluids increase in the sacs of the lungs, crowding out the oxygen.

I

Igniter—Any device used to begin combustion, such as a spark plug in the combustion chamber of a jet engine, or a squib used to ignite fuel in a rocket.

Impact Area—The area in which a rocket strikes the earth's surface.

Used specifically in reference to the "impact area" of a rocket range.

Impact Bag—An inflatable bag attached to a spacecraft or reentry capsule to absorb part of the shock of landing.

Inertial Guidance—Guidance by means of acceleration measured and integrated within the craft.

Infrared—Infrared radiation; electromagnetic radiation in the wavelength interval from the red end of the visible spectrum on the lower limit to microwaves used in radar on the upper limit.

Infrared Radiation (abbr IR)—Electromagnetic radiation lying in the wavelength interval from about 0.8 microns to an indefinite upper boundary sometimes arbitrarily set at 1,000 microns (0.01 cm). Also called "black light," "long wave radiation."

At the lower limit of this interval, the infrared radiation spectrum is bounded by visible radiation, while on its upper limit it is bounded by microwave radiation of the type important in radar technology.

Whereas visible radiation is generated primarily by intra-atomic processes, infrared radiation is generated almost wholly by larger-scale intramolecular processes, chiefly molecular rotations and internal vibrations of many types. Electrically symmetric molecules, such as the nitrogen and oxygen molecules which comprise most of the earth's atmosphere, are not capable of absorbing or emitting infrared radiation, but several of the triatomic gases, such as water vapor, carbon doxide, and ozone are infrared-active and play important roles in the propagation of infrared radiation in the atmosphere.

Since a black body at terrestrial temperature radiates with maximum intensity in the spectrum (near 10 microns), there exists a complex system of infrared radiation currents within our atmosphere.

Injection—1. The introduction of fuel, fuel and air, fuel and oxidizer, water, or other substance into an engine induction system or combustion chamber. 2. The process of putting an artificial satellite into orbit. 3. The time following launching when nongravitational forces (thrust, lift, and drag) become negligible in their effect on the trajectory of a space vehicle.

More than one injection is possible in a single flight if engines are stopped and restarted.

Insertion—The process of putting an artificial satellite into orbit. Also the time of such action.

Intensity—1. In general, the degree or amount, usually expressed by the elemental time rate or spatial distribution, of some condition or physical quantity, such as electric field, sound, magnetism, etc.

2. With respect to electromagnetic radiation, a measure of the radiant flux per unit solid angle emanating from some source. Frequently, it is desirable to specify this as radiant intensity in order to clearly distinguish it from luminous intensity.

Interface—The junction points or the points within or between systems or subsystems where matching or accommodation must be properly achieved in order to make their operation compatible with the successful operation of all other functional entities in the space vehicle and its ground support.

International Geophysical Year (abbr IGY)—By international agreement, a period during which greatly increased observation of world-wide geophysical phenomena is undertaken through the cooperative effort of participating nations. July 1957-December 1958 was the first such "year"; however, precedent was set by the International Polar Years of 1882 and 1921.

International Year of the Quiet Sun (abbr IQSY)—The international program for maximum observation and research in connection with expected period of low solar activity between April 1964 and December 1965.

Ion—An atom or molecularly bound group of atoms having an electric charge. Sometimes also a free electron or other charged subatomic particle.

Ionic Propulsion (electrostatic propulsion)—Rocket propulsion using the THRUST furnished by electrically accelerated ions. Much higher SPECIFIC IMPULSES and EXHAUST VELOCITIES may be obtained than with chemical propulsion, but current laboratory versions of the ionic rocket are capable of furnishing a total thrust of only a few ounces.

Ionosphere—The atmospheric shell characterized by a high ion density. Its base is at about 70 or 80 km and it extends to an indefinite height.

The ionosphere is classically subdivided into "layers." Each "layer," except the D-layer, is supposedly characterized by a more or less regular maximum of electron density.

D-layer.—The D-layer exists only in the daytime. It is not strictly a layer at all, since it does not exhibit a peak of electron or ion density, but is rather a region of increasing electron and ion density, starting at about 70 to 80 km and merging with the bottom of the E-layer.

The lowest clearly defined layer is the E-layer, occurring between 100 and 120 km. The F_1-layer and F_2-layer occur in the general region between 150 and 300 km, the F_2-layer being always present and having the higher electron density. The existence of a G-layer has been suggested, but is questionable. The portions of the ionosphere in which these "layers" tend to form are known as ionospheric "regions," as in "D-region," "E-region," "F-region," "G-region."

Sudden increases in ionization are referred to as "sporadic," as in "sporadic E" or "sporadic D."

The above assumption that the ionosphere is stratified in the vertical into discrete layers is currently under serious question. Some evidence supports a belief that ion clouds are the basic elements of the ionosphere. Other investigations appear to reveal the ionosphere as a generally ionized region charac-

terized by more or less random fluctuations of electron density.

Isotropic—In general, pertaining to a state which a quantity or spatial derivatives thereof are independent of direction.

IQSY—See International Year of the Quiet Sun.

J

Jerk—A vector that specifies the time rate of change of an acceleration; the third derivative of displacement with respect to time.

Joule's Constant—The ratio between heat and work units from experiments based on the first law of thermodynamics: 4.186 x 10^7 ergs/cal. Also called "mechanical equivalent of heat."

K

Kelvin Temperature Scale (abbr K)—An absolute temperature scale independent of the thermometric properties of the working substance. On this scale, the difference between two temperatures T_1 and T_2 is proportional to the heat converted into mechanical work by a Carnot engine operating between the isotherms and adiabats through T_1 and T_2. Also called "absolute temperature scale," "thermodynamic temperature scale."

For convenience the Kelvin degree is identified with the Celsius degree. The ice point in the Kelvin scale is 273.16°K. See **Absolute Zero.**

Kepler's Laws—The three empirical laws describing the motions of planets in their orbits, discovered by Johannes Kepler (1571-1630). These are: (1) The orbits of the planets are ellipses, with the sun at a common focus. (2) As a planet moves in its orbit, the line joining the planet and sun sweeps over equal areas in equal intervals of time. Also called "law of equal areas." (3) The squares of the periods of revolution of any two planets are proportional to the cubes of their mean distances from the sun.

Kev—A unit of energy, one thousand electron volts.

Kirchhoff's Law—The radiation law which states that at a given temperature the ratio of the emissivity to the absorptivity for a given wavelength is the same for all bodies and is equal to the emissivity of an ideal black body at that temperature and wavelength.

Loosely put, this important law asserts that good absorbers of a given wavelength are also good emitters of that wavelength. It is essential to note that Kirchhoff's law relates absorption and emission at the same wavelength and at the same temperature. Also called "Kirchhoff's radiation law."

L

Laser—(From light amplification by stimulated emission of radiation.) A device for producing light by emission of energy stored in a molecular or atomic system when simulated by an input signal.

Launch Pad—The load-bearing base or platform from which a rocket vehicle is launched. Usually called "pad."

Launch Ring—The metal ring on the launch pad on which a missile stands before launch.

Launch Vehicle—Any device which propels and guides a spacecraft into orbit about the earth or into a trajectory to another celestial body: Often called "booster."

Launch Window—An interval of time during which a rocket can be launched to accomplish a particular purpose as "lift-off occurred 5 minutes after the beginning of the 82-minute launch window."

Libration—A real or apparent oscillatory motion, particularly the apparent oscillation of the moon.

Because of libration, more than half of the moon's surface is revealed to an observer on the earth, even though the same side of the moon is always toward the earth because the moon's periods of rotation and revolution are the same.

Lift-off—The action of a rocket vehicle as it separates from its launch pad in a vertical ascent.

A lift-off is applicable only to vertical ascent; a take-off is applicable to ascent at any angle. A lift-off is action performed by a rocket; a launch is action performed upon a rocket or upon a satellite or spaceship carried by a rocket.

Light Year—The distance light travels in one year at rate of 186,000 miles per second (300,000 kilometers per second.) Equal to 5.9 × 10^{12} miles. See PARSEC.)

Line of Position—In navigation, a line representing all possible locations of a craft at a given instant.

In space this concept can be extended to "sphere of position," "plane of position," etc.

Liquid-Propellant Rocket Engine—A rocket engine fueled with propellant or propellants in liquid form. Also called "liquid-propellant rocket."

Rocket engines of this kind vary somewhat in complexity, but they consist essentially of one or more combustion chambers together with the necessary pipes, values, pumps, injectors, etc.

Local Vertical—At a particular point, the direction in which the force of gravity acts.

Longitudinal Axis—The fore-and-aft line through the center of gravity of a craft.

Longitudinal Vibration—Vibration in which the direction of motion of the particles is the same as the direction of advance of the vibratory motion.

This is in contrast with transverse vibration, in which the direction of motion is pependicular to that of advance.

Lox—1. Liquid oxygen. Used attributively as in "lox tank," "lox unit." Also called "loxygen." 2. To load the fuel tanks of a rocket vehicle with liquid oxygen. Hence, "loxing."

Lunar Atmospheric Tide—An atmospheric tide due to the gravitational attraction of the moon. The only detectable components are the 12-lunar-hour or semidiurnal, as in the oceanic tides, and two others of very nearly the same period. The amplitude of this atmospheric tide is so small that it is detected only by careful statistical analysis of a long record, being about 0.06 mb in the tropics and 0.02 mb in the middle latitudes.

Lyman Alpha Radiation—Ultraviolet radiation at a wavelength of 1216 Å emitted by atomic hydrogen when it passes from its first excited electronic state to its ground state. Light of this short wavelength is not transmitted by the earth's atmosphere, and a study of this extremely important line in the sun's spectrum was made only with the advent of rocket and satellite astronomy. The Lyman alpha transition is the longest wavelength member of the Lyman series of atomic hydrogen, and the strongest ultraviolet line emitted by the sun.

M

Mach Number—(After Ernst Mach (1838-1916), Austrian scientist.) A number expressing the ratio of the speed of a body or of a point on a body with respect to the surrounding air or other fluid, or the speed of a flow, to the speed of sound in the medium; the speed represented by this number.

If the Mach number is less than one, the flow is called "subsonic" and local disturbances can propagate ahead of the flow. If the Mach number is greater than one, the flow is called "supersonic" and disturbance cannot propagate ahead of the flow, with the result that shock waves form.

Magnetic Storm—A worldwide disturbance of the earth's magnetic field.

Magnetic storms are frequently characterized by a sudden onset, in which the magnetic field undergoes marked changes in the course of an hour or less, followed by a very gradual return to normality, which may take several days. Magnetic storms are caused by solar disturbances, though the exact nature of the link between the solar and terrestrial disturbances is not understood. Sometimes a magnetic storm can be linked to a particular solar disturbance. In these cases, the time between solar flare and onset of the magnetic storm is about one or two days, suggesting that the disturbance is carried to the earth by a cloud of particles thrown out by the sun.

Magnetohydrodynamics—The study of the interaction that exists between a magnetic field and an electrically conducting fluid. Also called "magnetoplasmadynamics," "magnetogasdynamics," "hydromagnetics," "MHD."

Magnetometer—An instrument used in the study of geomagnetism for measuring any magnetic element.

Magnetosphere—That part of the earth's atmosphere which exists by virtue of the earth's magnetic field. The magnetosphere consists of trapped particles, mainly electrons and protons, which spiral about the magnetic lines of force from pole to pole, and gradually precess eastward or westward, depending on their charge. Particles are lost by the magnetosphere when they descend into the atmosphere at high latitudes. It is believed that particles are fed into the magnetosphere by effects associated with the arrival of PLASMA clouds ejected during SOLAR FLARES as well as from the beta decay of neutrons produced by COSMIC RAYS striking the upper atmosphere. Particles may also be injected into the magnetosphere by high altitude nuclear explosions. (See VAN ALLEN BELTS.)

Magnitude—Relative brightness of a celestial body. The smaller the magnitude number, the brighter the body.

Decrease of light by a factor of 100 increases the stellar magnitude by 5.00; hence the brightest objects have negative magnitudes. (Sun: −26.8; mean full moon; −12.5; Venus at brightest: −4.3; Jupiter at opposition: −2.3; Sirius: −1.6; Vega: +0.2; Polaris: +2.1). The faintest stars visible to the Naked eye on a clear dark night are of about the sixth magnitude.

Main Bang—Within a radar system, the transmitted pulse.

Main Stage—1. In a multistage rocket, the stage that develops the greatest amount of thrust, with or without booster engines. 2. In a single-stage rocket vehicle powered by one or more engines, the period when full thrust (at or above 90 percent) is attained. 3. A sustainer engine, considered as a stage after booster engines have fallen away, as in "the main stage of the Atlas."

Manometer—An instrument for measuring pressure of gases and vapors both above and below atmospheric pressure.

Maria—The large, darker areas, of generally circular outline on the lunar surface. It has been suggested that they are caused by lava flow following the impact of large meteorites during the last stages of formation of the moon.

Mariner—The initial unmanned exploration of the planets is being conducted in the United States under the Mariner program. Mariner 2, launched August 26, 1962, passed within 21,000 miles of Venus on December 14, 1962, and radioed to earth information concerning the infrared and microwave emission of the planet, and the strength of the planet's magnetic field. Future flyby missions to both Venus and Mars are planned.

Mars I— An instrumented spacecraft launched by the Soviet Union on November 1, 1962, designed to investigate the interplanetary medium and transmit photographs of Mars to the earth. It is programmed to pass the planet in June, 1963, when it will be at a distance of 150 million miles.

Maser—An amplifier utilizing the principle of microwave amplification by stimulated emission of radiation. Emission of energy stored in a molecular or atomic system by a microwave power supply is stimulated by the input signal.

Mass—The measure of the amount of matter in a body, thus its inertia.

The weight of a body is the force with which it is attracted by the earth.

Mass-Energy Equivalence—The equivalence of a quantity of mass m and a quantity of energy E, the two quantities being related by the mass-energy relation, $E = mc^2$, where c = the speed of light.

Mass Ratio—The ratio of the mass of the propellant charge of a rocket to the total mass of the rocket charged with the propellant.

Mate—To fit together two major components of a system.

Mean Free Path—Of any particle, the average distance that a particle travels between successive collisions with the other particles of an ensemble.

Mechanoreceptor—A nerve ending that reacts to mechanical stimuli, as touch, tension, and acceleration.

Mega—A prefix meaning multiplied by one million as in "megacycles."

Memory—The component of a computer, control system, guidance system, instrumented satellite, or the like designed to provide ready access to data or instructions previously recorded so as to make them bear upon an immediate problem, such as the guidance of a physical object, or the analysis and reduction of data.

Mercury—The initial man-in-space program of the United States. The first manned sub-orbital flight took place on April 23, 1961, and the first orbital mission on February 20, 1962. Two others followed on May 24, 1962 and October 3, 1962. An 18 orbit flight is scheduled for April, 1963.

Mesosphere—1. The atmospheric shell between about 20 km and about 70 or 80 km, extending from the top of the stratosphere to the upper temperature minimum (the mesopause.) It is characterized by a broad temperature maximum (the mesopeak) at about 50 km, except possibly over the winter polar regions.

2. The atmospheric shell between the top of the ionosphere (the top of this region has never been clearly defined) and the bottom of the exosphere. (This definition has not gained general acceptance.)

Meteor—In particular, the light phenomenon which results from the entry into the earth's atmosphere of a solid particle from space: more generally, any physical object or phenomenon associated with such an event.

Meteoric—Of or pertaining to meteors, or meteoroids.

Meteorite—A meteoroid which has reached the surface of the earth without being completely vaporized.

Meteorid—A solid object moving in interplanetary space, of a size considerably smaller than an asteroid and considerably larger than an atom or molecule.

Meteorological Rocket—A rocket designed primarily for routine upper-air observation (as opposed to research) in the lower 250,000 feet of the atmosphere, especially that portion inaccessible to balloons, i.e., above 100,000 feet. Also called "rocketsonde."

MEV—A unit of energy, one million electron volts.

Micro—1. A prefix meaning divided by one million. 2. A prefix meaning very small as in "micrometeorite."

Microbar (abbr μb)—The unit of pressure in the c.g.s. system and equal to one dyne per square centimeter.

Micrometeorite—A very small meteorite or meteoritic particle with a diameter in general less than a millimeter.

Micron—One millionth of a meter, abbreviated μ.

Microwave Region—Commonly, that region of the radio spectrum between approximately 1000 Mc and 300,000 Mc.

Corresponding wavelengths are 30 cm to 1 mm.

The limits of the microwave region are not clearly defined but in general it is considered to be the region in which radar operates.

Millibar—A unit of pressure equal to 1,000 dynes per square centimeter, or 1/1,000 of a bar.

The millibar is used as a unit of measure of atmospheric pressure, a standard atmosphere being equal to 1,013.25 millibars or 29.92 inches of mercury.

Mini.—A contraction of "minitaure" used in combination, as in "minicomponent," "miniradio," "minitransistor."

Miniaturize—To construct a functioning miniature of a part or instrument. Said of telemetering instruments or parts used in an earth satellite or rocket vehicle, where room is at a premium. Hence, "miniaturized," "miniaturization."

Minimum Ionizing Speed—The speed with which a free electron must move through a given gas to be able to ionize gas atoms or molecules by collision. In air at standard conditions, this speed is about 10^7 cm/sec.

Minitrack—A satellite tracking system consisting of a field of separate antennas and associated receiving equipment interconnected so as to form interferometers which track a transmitting beacon in the satellite itself.

Missile—Any object thrown, dropped, fired, launched, or otherwise projected with the purpose of striking a target. Short for "ballistic missile," "guided missile."

Missile is loosely used as a synonym for "rocket" or "spacecraft" by some careless writers.

Mock-Up—A full-sized replica or dummy of something, such as a spacecraft, often made of some substitute material, such as wood, and sometimes incorporating functioning pieces of equipment, such as engines.

Mode of Propagation—In transmission, a form of propagation of guided waves that is characterized by a particular field pattern in a plane transversed to the direction of propagation, which field pattern is independent of position along the axis of the waveguide.

In the case of uniconductor waveguides the field pattern of a particular mode of propagation is also independent of frequency.

Mode of Vibration—In a system undergoing vibration, a characteristic pattern assumed by the system, in which the motion of every particle is simple harmonic with the same frequency.

Two or more modes of vibration may exist concurrently in a multiple-degree-of-freedom system.

infrared, visible, ultraviolet, and x-ray regions from a stabilized platform above the obscuring effects of the earth's atmosphere. The first OAO will be launched using an ATLAS-AGENA by the United States late in 1963 or early in 1964, with successive flights at six-month intervals.

Occultation—The disappearance of a body behind another body of larger apparent size.

When the moon passes between the observer and a star, the star is said to be occulted.

Octave—The interval between any two frequencies having the ratio of 1:2.

The interval in octaves between any two frequencies is the logarithm to the base 2 (or 3.322 times the logarithm to the base 10) of the frequency ratio.

Oculogravic Illusion—The apparent displacement of an object in space caused by the difference which may exist between the direction of the vertical and that of resultant g.

Oculogyral Illusion—The apparent movement of an object in the same direction as that in which one seems to be turning when the semicircular canals of the inner ear are stimulated.

OGO—The Orbiting Geophysical Observatory will be a standardized satellite designed to undertake a large variety of geophysical experiments, including investigations of the MAGNETOSPHERE, the earth's magnetic field, MICROMETEORITES, and radio propagation. The first launching using an ATLAS-AGENA is scheduled by the United States for 1963, the following for 1964.

Orbit—1. The path of a body or particle under the influence of a gravitational or other force. For instance, the orbit of a celestial body is its path relative to another body around which it revolves. 2. To go around the earth or other body in an orbit.

Orbital Elements—A set of 7 parameters defining the orbit of a satellite.

Orbital Period—The interval between successive passages of a satellite.

Orbital Velocity—1. The average velocity at which an earth satellite or other orbiting body travels around its primary. 2. The velocity of such a body at any given point in its orbit, as in "its orbital velocity at the apogee is less than at the perigee."

Order of Magnitude—A factor of 10.

Two quantities of the same kind which differ by less than a factor of 10 are said to be of the same order of magnitude. "Order of magnitude" is used loosely by many writers to mean a pronounced difference in quantity but with the difference much less or much more than a factor of 10.

Orthogonal—At right angles.

OSO—The Orbiting Solar Observatory. OSO I was launched by the United States on March 7, 1962. It is designed in particular to gather information on the emission by the sun of x and y rays, ultraviolet light, neutrons, protons, and electrons which cannot be obtained from the earth's surface. A second similar OSO will be launched in 1963, with improved versions following.

Otolith—A small calcareous concretion located in the inner ear which plays a part in the mechanism of orientation.

Outgassing—The evolution of gas from a solid in a vacuum.

Oxidizer—Specifically, a substance (not necessarily containing oxygen) that supports the combustion of a fuel or propellant.

OZONE—The molecule O_3. It is produced in the upper STRATOSPHERE by the PHOTODISSOCIATION of O_2 and subsequent union of O and O_2. Ozone absorbs ultraviolet strongly in the wavelength region from 2000 to 3000 Å.

Ozonosphere—The general stratum of the upper atmosphere in which there is an appreciable ozone concentration and in which ozone plays an important part in the radiative balance of the atmosphere. This region lies roughly between 10 and 50 km, with maximum ozone concentration at about 20 to 25 km. Also called 'ozone layer.'

P

Pad = Launch Pad.

Paraglider—A flexible-winged, kite-like vehicle designed for use in a recovery system for launch vehicles or as a reentry vehicle.

Parameter—1. In general, any quantity of a problem that is not an independent variable. More specifically, the term is often used to distinguish, from dependent variables, quantities which may be more or less arbitrarily assigned values for purposes of the problem at hand. 2. In statistical terminology, any numerical constant derived from a population or a probability distribution. Specifically, it is an arbitrary constant in the mathematical expression of a probability distribution.

Parsec—A unit of distance commonly used to measure interstellar dimensions. It is the distance at which an ASTRONOMICAL UNIT, the mean distance of the earth from the sun, would subtend an angle of one second of an arc. A parsec equals 3.26 LIGHT YEARS.

Part—An element of a component, assembly or subassembly which is not normally subject to further subdivision or disassembly or maintenance purposes. Examples are: resistors, transformers, electron tubes, relays, etc.

Passive—Reflecting a signal without transmission, as "Echo is a passive satellite." Contrasted with "active."

Payload—1. Originally, the revenue-producing portion of an aircraft's load, e.g., passengers, cargo, mail, etc. 2. By extension, that which an aircraft, rocket, or the like carries over and above what is necessary for the operation of the vehicle during its flight.

Peri—A prefix meaning near, as in "perigee."

Perigee—That orbital point nearest the earth when the earth is the center of attraction.

That orbital point farthest from the earth is called "apogee." Perigee and apogee are used by many writers in referring to orbits of satellites, especially artificial satellites, around any planet or satellite, thus avoiding coinage of new terms for each planet and moon.

Perihelion—For an elliptic orbit about the sun, the point closest to the sun.

Pencil-Beam Antenna.—A unidirectional antenna, so designed that cross sections of the major lobe by planes perpendicular to the direction of maximum radiation are approximately circular.

Perihelion—That orbital point nearest the sun when the sun is the center of attraction.

That orbital point farthest from the sun is called "aphelion." The term "perihelion" should not be confused with "parhelion," a form of halo.

Period—The interval needed to complete a cycle. Often used in reference to time of complete orbit.

Perturbation—Specifically, a disturbance in the regular motion of a celestial body, the result of a force additional to those which cause the regular motion.

Photodissociation—The removal of one or more atoms from a molecule by the absorption of a quantum of electromagnetic or photon energy. The energy of the photon absorbed by a system such as an atom or molecule increases in direct proportion to the frequency of the radiation. Simple molecules such as O_2, N_2, CO_2, H_2O which are the primary molecular constituents of the atmosphere can only be photodissociated by ultraviolet or higher frequency (shorter wavelength) light. They are not dissociated by visible light. (See PHOTOIONIZATION.)

Photoionization—The removal of one or more electrons from an atom or molecule by the absorption of a photon. As with PHOTODISSOCIATION, ultraviolet or shorter wavelength light is required to photoionize simple molecules.

Photon—According to the quantum theory of radiation, the elementary quantity, or "quantum" of radiant energy. It is regarded as a discrete quantity having a mass equal to hv/c^2, where h is Planck's constant, v the frequency of radiation, and c the speed of light in a vacuum.

Photon Engine—A projected type of reaction engine in which thrust would be obtained from a stream of electromagnetic radiation.

Although the thrust of this engine would be minute, it may be possible to apply it for extended periods of time. Theoretically, in space, where no resistance is offered by air particles, very high speeds may be built up.

Photosphere—The intensely bright portion of the sun visible to the unaided eye. The photosphere is that portion of the sun's atmosphere which emits the continuous radiation upon which the Fraunhofer lines are superimposed. In one sun model, the photosphere is thought to be below the reversing layer in which Fraunhofer absorption takes place. In another model, all strata are considered equally effective in producing continuous emissions and line absorption.

Physiological acceleration—The acceleration experienced by a human or an animal test subject in an accelerating vehicle.

Pickoff—A sensing device, used in combination with a gyroscope in an automatic pilot or other automatic or robot apparatus, that responds to angular movement to create a signal or to effect some type of control.

Pickup—1. A device that converts a sound, scene, or other form of intelligence into corresponding electric signals (e.g., a microphone, a television camera, or a phonograph pickup.) 2. The minimum current, voltage, power, or other value at which a relay will complete its intended function. 3. Interference from a nearby circuit or system.

Pico—A prefix meaning divided by one million million.

Pioneer—A series of DEEP SPACE PROBES designed to investigate the interplanetary medium. Pioneer I, launched October 11, 1959, determined the radial extent of the earth's MAGNETOSPHERE, and made the first determination of the density of MICROMETEORITES in space. Pioneer 5, launched March 11, 1960 made the first measurements of the effects of a SOLAR FLARE far from the earth's magnetic field, and established a record of radio communication of 22.5 million miles, since exceeded only by MARINER 2.

Pip—Signal indication on the scope of an electronic instrument, produced by a short, sharply peaked pulse of voltage. Also called "blip."

Pitchover—The programed turn from the vertical that a rocket under power takes as it describes an arc and points in a direction other than vertical.

Plages—Clouds of calcium or hydrogen vapor that show up as bright patches on the visible surface of the sun.

Planck's Constant (abbr h)—A constant, usually designated h, of dimensions mass x length^2 x time $^{-1}$ equal to 6.6252×10^{-27} erg sec. It scales the energy of electromagnetic radiation of frequency v such that the radiation appears only in quanta nhv, n being an integer.

Planck's Law—An expression for the variation of monochromatic emittance (emissive power) as a function of wavelength of black-body radiation at a given temperature; it is the most fundamental of the radiation laws.

Planet—A celestial body of the solar system, revolving around the sun in a nearly circular orbit, or a similar body revolving around a star.

The larger of such bodies are sometimes called "principal planets" to distinguish them from asteroids, planetoids, or minor planets, which are comparatively very small.

An inferior planet has an orbit smaller than that of the earth; a superior planet has an orbit larger than that of the earth. The four planets nearest the sun are called "inner planets"; the others, "outer planets." The four largest planets are called "major planets." The world "planet" is of Greek origin meaning, literally, wanderer, applied because the planets appear to move relative to the stars.

Plasma—An electrically conductive gas comprised of neutral particles, ionized particles, and free electrons but which, taken as a whole, is electrically neutral.

A plasma is further characterized by relatively large intermolecular distances, large amounts of energy stored in the internal energy levels of the

Modulation—Specifically, vibration of some characteristic of a radio wave, called the "carrier wave," in accordance with instantaneous values of another wave, called the "modulating wave."

Variation of amplitude is amplitude modulation, variation of frequency is frequency modulation, and variation of phase is phase modulation. The formation of very short bursts of a carrier wave, separated by relatively long periods during which no carrier wave is transmitted, is pulse modulation.

Module—1. A self-contained unit of a launch vehicle or spacecraft which serves as a building block for the overall structure. The module is usually designated by its primary function as "command module," "lunar landing module," etc. 2. A one-package assembly of functionally associated electronic parts; usually a plug-in unit.

Module—An aggregate of two or more atoms of a substance that exists as a unit.

Molecule—An aggregate of two or more atoms of a substance that exists as a unit.

Moment (abbr M)—A tendency to cause rotation about a point or axis, as of a control surface about its hinge or of an airplane about its center of gravity; the measure of this tendency, equal to the product of the force and the perpendicular distance between the point of axis of rotation and the line of action of the force.

Moment of Inertia (abbr I)—Of a body about an axis, the Σmr^2, where m is the mass of a particle of the body and r its distance from the axis.

Momentum—Quantity of motion.

Linear momentum is the quantity obtained by multiplying the mass of a body by its linear speed. Angular momentum is the quantity obtained by multiplying the moment of inertia of a body by its angular speed.

The momentum of a system of particles is given by the sum of the moments of the individual particles which make up the system, or by the product of the total mass of the system and the velocity of the center of gravity of the system.

The momentum of a continuous medium is given by the integral of the velocity over the mass of the medium, or by the product of the total mass of the medium and the velocity of the center of gravity of the medium.

Monopropellant—A rocket propellant consisting of a single substance, especially a liquid, capable of producing a heated jet without the addition of a second substance.

M-Region—Name given to a region of activity on the sun when the nature of that activity cannot be determined.

The M-region used in accounting for recurrent magnetic storms with a period the same as the period of solar rotation relative to the earth, 27.3 days. See **Magnetic Storms.**

Multiplexer—A mechanical or electrical device for sharing of a circuit by two or more coincident signals.

Multiplexing—The simultaneous transmission of two or more signals within a single channel.

The three basic methods of multiplexing involve the separation of signals by time division, frequency division, and phase division.

Multipropellant—A rocket propellant consisting of two or more substances fed separately to the combustion chamber.

Multistage Rocket—A vehicle having two or more rocket units, each unit firing after the one in back of it has exhausted its propellant. Normally, each unit, or stage, is jettisoned after completing its firing. Also called a "multiple-stage rocket" or, infrequently, a "step rocket."

Musa Antenna—A "multiple-unit steerable antenna" consisting of a number of stationary antennas, the composite major lobe of which is electrically steerable.

N

NACA (abbr)—National Advisory Committee of Aeronautics.

Nano—A prefix meaning divided by one billion, as in "nanosecond," one billionth of a second.

Nanosecond (abbr nsec)—10^{-9} second. Also called "millimicrosecond."

NASA (abbr)—National Aeronautics and Space Administration.

NASC (abbr)—National Aeronautics and Space Council.

Natural Frequency—1. The frequency of free oscillation of a system. For a multiple-degree-of-freedom system, the natural frequencies are the frequencies of the normal modes of vibration. 2. The undamped resonant frequency of the rotor gimbal and its elastic restraint. It is expressed in cycles per unit time. 3. Specifically, of a gyro.

Nautical Mile—A unit of distance used principally in navigation. For practical navigation it is usually considered the length of one minute of any great circle of the earth, the meridian being the great circle most commonly used. Also called "sea mile." By international agreement of 1 July 1959, U.S., Great Britain and nearly all maritime nations established the International Nautical Mile, equal to exactly 1852 meters. Using the yard-meter conversion factor effective July 1, 1959, the International Nautical Mile is equivalent to 6,076.11549 international feet.

NASA's Designated Representative—A representative of the NASA installation stationed at supplier's plant or a representative of the inspection agency to whom quality assurance functions have been delegated.

NASA Installation—A major organization unit of the NASA; includes Headquarters and field installations. Field installations are assigned specific missions in the NASA space program.

Neutron—A subatomic particle with no electric charge, and with a mass slightly more than the mass of the proton.

Protons and neutrons comprise atomic nuclei; and they are both classed as nucleons.

Neutrosphere—The atmospheric shell from the earth's surface upward in which the atmospheric constituents are for the most part un-ionized, i.e., electrically neutral.

The region of transition between the neutrosphere and the ionosphere is somewhere between 70 and 90 km, depending on latitude and season.

Newton's laws of motion—A set of three fundamental postulates forming the basis of the mechanics of rigid bodies, formulated by Newton in 1687.

The first law is concerned with the principle of inertia and states that if a body in motion is not acted upon by an external force, its momentum remains constant (law of conservation of momentum.) The second law asserts that the rate of change of momentum of a body is proportional to the force acting upon the body and is the direction of the applied force. A familiar statement of this is the equation

$$F = ma$$

Where F is vector sum of the applied forces, m the mass, and a the vector acceleration of the body. The third law is the principle of action and reaction, stating that for every force acting upon a body there exists a corresponding force of the same magnitude exerted by the body in the opposite direction.

Noctilucent Clouds—Rarely observed clouds of unknown composition which occur at great height. Photometric measurements have located them between 75 and 90 km. They resemble thin cirrus, but usually with a bluish or silverish color, although sometimes orange to red, standing out against a dark night sky. Sometimes called "luminous clouds."

Node—1. One of the two points of intersection of the orbit of a planet, planetoid, or comet with the ecliptic, or of the orbit of a satellite with the plane of the orbit of its primary. Also called "nodal point."

That point at which the body crosses to the north side of the reference plane is called the ascending node; the other, the descending node. The line connecting the nodes is called line of nodes.

2. A point, line, or surface in a standing wave where some characteristic of the wave has essentially zero amplitude.

The appropriate modifier should be used before the word "node" to signify the type that is intended; e.g., displacement node, velocity node, pressure node.

3. A terminal of any branch of a network or a terminal common to two or more branches of a network. Also called "junction point," "branch point," or "vertex."

Noise—1. Any undesired sound. By extension, noise is any unwanted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device. When caused by natural electrical discharges in the atmosphere noise may be called "static."

2. An erratic, intermittent, or statistically random oscillation.

If ambiguity exists as to the nature of the noise, a phrase such as "acoustic noise" or "electric noise" should be used.

Since the above definitions are not mutually exclusive, it is usually necessary to depend upon context for distinction.

Nonrelativistic Particles—Particles which possess a velocity small with respect to that of light, which is 186,000 miles/second or 3×10^{10} centimeters per second. (See RELATIVISTIC PARTICLES.)

Nonthermal Radiation—Electromagnetic radiation emitted by accelerated charged particles not in thermal equilibrium. The distribution of energy with frequency of nonthermal radiation usually differs from that of blackbody or THERMAL RADIATION. CYCLOTRON and SYNCHROTRON RADIATION of charged particles in magnetic fields are examples of nonthermal radiation, as is the light from a fluorescent lamp or the AURORA.

Normal Mode of Vibration—A mode of free vibration of an undamped system. In general, any composite motion of a vibrating system is analyzable into a summation of its normal modes, also called natural mode, "characteristic mode," and "eigen mode."

Normal Shock Wave—A shock wave perpendicular, or substantially so, to the direction of flow in a supersonic flow field. Sometimes shortened to "normal shock."

Nosecone—The cone-shaped leading end of a rocket vehicle, consisting of (a) a chamber or chambers in which a satellite, instruments, animals, plants, or auxiliary equipment may be carried, and (b) an outer surface built to withstand high temperatures generated by aerodynamic heating.

In a satellite vehicle, the nosecone may become the satellite itself after separating from the final stage of the rocket or it may be used to shield the satellite until orbital speed is accomplished, then separating from the satellite. See **Shroud.**

Nozzle—Specifically, the part of a rocket thrust chamber assembly in which the gases produced in the chamber are accelerated to high velocities.

Nuclear Fuel—Fissionable material of reasonably long life, used or usable in producing energy in a nuclear reactor.

Nuclear Radiation—The emission of neutrons and other particles from an atomic nucleus as the result of nuclear fission or nuclear fusion.

Nuclear Reactor—An apparatus in which nuclear fission may be sustained in self-supporting chain reaction. Commonly called "reactor."

Nucleosynthesis—The production of the various elements occurring in nature out of hydrogen nuclei or protons. Examples of nucleosynthesis are: thermonuclear reactions in stars and interactions involving fast, charged particles (COSMIC RAYS) near stars or in the interstellar medium.

Nucleus—The positively charged core of an atom with which is associated practically the whole mass of the atom but only a minute part of its volume.

A nucleus is composed of one or more protons and an approximately equal number of neutrons.

O

OAO—The Orbiting Astronomical Observatory which will make possible telescopic observations in the

particles and by the presence of a plasma sheath at all boundaries of the plasma.

Plasmas are sometimes referred to as a fourth state of matter.

Plasma Engine—A reaction engine using magnetically accelerated plasma as propellant.

A plasma engine is a type of electrical engine.

Plasma Jet—A magnetohydrodynamic rocket engine in which the ejection of plasma generates thrust.

Plasma Sheath—1. The boundary layer of charged particles between a plasma and its surrounding walls, electrodes, or other plasmas.

The sheath is generated by the interaction of the plasma with the boundary material. Current flow may be in only one direction across the sheath (single sheath), in both directions across the sheath (double sheath), or when the plasma is immersed in a magnetic field, may flow along the sheath surface at right angles to the magnetic field (magnetic current sheath.)

2. An envelope of ionized gas that surrounds a body moving through an atmosphere at hypersonic velocities.

The plasma sheath affects transmission, reception, and diffraction of radio waves; thus is important in operational problems of spacecraft, especially during reentry.

Pod—An enclosure, housing, or detachable container of some kind, as: (a) an engine pod, (b) an ejection capsule.

Polarization—1. The state of electromagnetic radiation when transverse vibrations take place in some regular manner, e.g., all in one plane, in a circle, in an ellipse, or in some other definite curve.

Radiation may become polarized because of the nature of its emitting source, as is the case with many types of radar antennas, or because of some processes to which it is subjected after leaving its source, as that which results from the scattering of solar radiation as it passes through the earth's atmosphere.

Posigrade Rocket—An auxiliary rocket which fires in the direction in which the vehicle is pointed, used for example in separating two stages of a vehicle.

Pound (abbr lb)—1. A unit of weight equal in the United States to 0.45359237 kilograms. 2. Specifically, a unit of measurement for the thrust or force of a reaction engine representing the weight the engine can move, with 100,000 pounds of thrust.

Precession—Change in the direction of the axis of rotation of a spinning body, as a gyroscope, when acted upon by a torque.

The direction of motion of the axis is such that it causes the direction of spin of the gyroscope to tend to coincide with that of the impressed torque. The horizontal component of precession is called "drift," and the vertical component is called "topple."

Precession of the Equinoxes—The conical motion of the earth's axis about the vertical to the plane of the ecliptic, caused by the attractive force of the sun, moon, and other planets on the equatorial protuberance of the earth.

Pressure (abbr p)—As measured in a vacuum system, the quantity measured at a specified time by a so-called vacuum gage, whose sensing element is located in a cavity (gage tube) with an opening oriented in a specified direction at a specified point within the system, assuming a specified calibration factor.

The sensitivity of the sensing element is in general not the same for all molecular species, but the gage reading is frequently reported using the calibration factor for air regardless of the composition of the gas. The opening to the gage tube is often carelessly oriented with respect to mass-flow vectors in the gas (which is seldom at rest), and errors due to variations in wall temperatures of tube and system are frequently neglected. The actual total pressure in a high-vacuum system cannot usually be measured by a single gage, but in vacuum technology the term "total pressure" is sometimes used to refer to the reading of a single untrapped gage which responds to condensable vapors as well as permanent gases.

Pressure Suit—A garment designed to provide the human body an environment above ambient pressure so that respiratory and circulatory functions may continue normally, or nearly so, under low-pressure conditions, such as occur at high altitudes or in space without benefit of a pressurized cabin.

Pressurized—Containing air, or other gas, at a pressure that is higher than the pressure outside the container.

Prestage—A step in the action of igniting a large liquid rocket taken prior to the ignition of the full flow, and consisting of igniting a partial flow of propellants into the thrust chamber.

Primary—1. Short for "primary body." 2. Short for "primary cosmic ray."

Primary Body—The spatial body about which a satellite or other body orbits, or from which it is escaping, or towards which it is falling.

The primary body of the moon is the earth; the primary body of the earth is the sun.

Primary Cosmic Rays—High energy particles originating outside the earth's atmosphere.

Primary cosmic rays appear to come from all directions in space. Their energy appears to range from 10^9 to more than 10^{17} electron volts.

Probable Error (abbr pe)—In statistics, that value e_p for which there exists an even probability (0.5) that the actual error exceeds e_p. The probable error e_p is 0.6745 times the standard deviation σ.

The probable error is not "probable" in the normal sense of the word.

Probability—The chance that a prescribed event will occur, represented as a number greater than zero but less than one. The probability of an impossible event is zero, and that of an inevitable event is one.

Probe—Any device inserted in an environment for the purpose of obtaining information about the environment. Specifically, an instrumented vehicle moving through the upper atmosphere or space or landing upon another celestial body in order to obtain information about the specific environment.

Almost any instrumented spacecraft can be considered a probe. However, earth satellites are not usually referred to as "probes." Also, almost any instrumented rocket can be considered a probe. In practice, rockets which attain an altitude of less than one earth radius (4000 miles) are called "sounding

rockets," those which attain an altitude of more than one earth radius are called "probes" or "space probes." Spacecraft which enter into orbit around the sun are called "deep-space probes." Spacecraft which enter into orbit around the sun are called "deep-space probes." Spacecraft designed to pass near or land on another celestial body are often designated "lunar probe," "Martian probe," "Venus probe," etc.

Prominence—A filament-like protuberance from the chromosphere of the sun.

Prominences can be observed (optically) whenever the sun's disk is masked, as during an eclipse or using a coronagraph; and can be observed instrumentally by filtering in certain wavelengths, as with a spectroheliograph. A typical prominence is 6,000 to 12,000 km thick, 60,000 km high, and 200,000 km long.

Propellant—Short for "rocket propellant."

Prospector—The successor to the Surveyor program with the mission of obtaining detailed photographs of the lunar surface, SOFT-LANDING mobile, automated laboratories on the moon, and returning lunar soil samples to the earth for analysis.

Proton—A positively-charged subatomic particle having a mass slightly less than that of a neutron but about 1847 times greater than that of an electron. Essentially, the proton is the nucleus of the hydrogen isotope $_1H^1$ (ordinary hydrogen stripped of its orbital electron.) Its electric charge ($+4.8025 \times 10^{-10}$ esu) is numerically equal, but opposite in sign, to that of the electron.

Protons and neutrons comprise atomic nuclei; they are both classed as "nucleons."

Prototype—Spacecraft or element thereof which is undergoing or has passed environmental and other tests which qualify design for fabrication of flight units or elements thereof.

Proving Stand—A test stand for reaction engines, especially rocket engines.

Purge—To rid a line or tank of residual fluid, especially of fuel or oxygen in the tanks or lines of a rocket after a test firing or simulated test firing.

Q

q = Dynamic Pressure.

Quantization—The process of converting from continuous values of information to a finite number of discrete values.

Quantum theory—The theory (first stated by Max Planck before the Physical Society of Berlin on December 14, 1900) that all electromagnetic radiation is emitted and absorbed in "quanta" each of magnitude $h\nu$, h being Planck's constant and ν the frequency of the radiation.

Quiet Sun—See "Year of the Quiet Sun."

R

Radar Astronomy—The development of powerful radar transmitters, large antennas, and very sensitive receivers allows the detection of high frequency radio waves (radar) reflected off the nearby members of the solar system. Signals reflected from the moon were first detected in 1945, while the first signals from Venus were unambiguously received in 1961. A careful analysis of the reflected signal gives information as to the distance, velocity of approach or recession, surface roughness, rate of rotation, and dielectric constant of the planet. A large antenna with an aperture of 1000 feet under construction in Puerto Rico should allow radar detection of Mercury, Mars, some of the asteroids, the satellites of Jupiter, and the planet Jupiter itself, if the dense Jovian atmosphere does not absorb all of the incident radar signal.

Radiation—Short for "electromagnetic radiation," "nuclear radiation."

Radiation Belts—See VAN ALLEN BELTS, MAGNETOSPHERE.

Radiation Pressure (abbr Pr)—Pressure exerted upon any material body when electromagnetic radiation is incident upon body.

This pressure is manifested whenever the electromagnetic momentum in a radiation field is changed, and is exactly twice as great when the radiation is reflected at normal incidence as it is when the radiation is entirely absorbed at normal incidence. The magnitude of any radiation pressure effect is directly proportional to the intensity of the radiation, and is very small by most standards.

On a perfectly reflecting surface $Pr = v/3$ where v = radiation density the amount of radiative energy per unit volume in the space above the surface. Radiation pressure has perceptible effect on the orbit of earth satellites, especially those with a large reflecting surface such as Echo.

Radiation Shield—1. A device used on certain types of instruments to prevent unwanted radiation from biasing the measurement of a quantity. 2. A device used to protect bodies from the harmful effects of nuclear radiation, cosmic radiation, or the like.

Radiator—1. Any source of radiant energy, especially electromagnetic radiation. 2. A device that dissipates heat from something, as from water or oil, not necessarily by radiation only.

Generally, the application of the terms "radiator" (in sense 2) or "heat exchanger" to a particular apparatus depends upon the point of view: If the emphasis is upon merely getting rid of heat, "radiator" is most often used, or sometimes "cooler"; if the emphasis is upon transferring heat, "heat exchanger" is used—but these distinctions do not always hold true.

Radio Astronomy—The earth's atmosphere is transparent to electromagnetic radiation in only two frequency bands, or "windows". The familiar "optical window" lies in the wavelength interval from 3000 Å to a few MICRONS. Practically all astronomy and astrophysics prior to thirty years ago was based on the

information received through this window. Since that time, the development of sensitive electronic receivers and the construction of large antennas has allowed the detection of radio waves from astronomical sources which pass through the atmosphere in the "radio window," from a wavelength of a few millimeters to a few tens of meters. Radio astronomy has furnished information about the moon, the planets, the sun, the interstellar medium (in particular the distribution of atomic hydrogen), supernova fragments, and the structure of galaxies.

Radiometer—A device used to measure some property of electromagnetic radiation. In the visible and ultraviolet regions of the spectrum, a photocell or photographic plate may be thought of as a radiometer. In the infrared, solid state detectors such as photoconductors, lead sulfide cells and thermocouples are used, while in the radio and microwave regions, vacuum tube receivers, often with parametric or maser preamplifiers, are the most sensitive detectors of electromagnetic radiation.

Radio Meteor—A meteor detected by the reflection of a radio signal from the meteor trail of relatively high ion density (ion column).

Such an ion column is left behind a meteoroid when it reaches the region of the upper atmosphere between about 80 and 120 km, although occasionally radio meteors are detected at higher altitudes.

Radiosonde—A balloon-borne instrument for the simultaneous measurement and transmission of meteorological data.

Radio Telescope—A device for receiving, amplifying, and measuring the intensity of radio waves originating outside the earth's atmosphere.

Ranger—The initial United States program for the investigation of the moon, and the region between the moon and the earth. Early versions of the Ranger are designed to provide closeup television photographs of the lunar surface, and to rough-land seismographs on the moon.

Rarefied Gas Dynamics—The study of the phenomena related to the molecular or noncontinuum nature of gas flow at low densities.

Rayleigh-Jeans Law—An approximation to PLANCK'S LAW for blackbody radiation valid in the limit of long wavelengths. It is almost always of sufficient accuracy in the radio and microwave regions of the spectrum.

Reaction Control System—A system of controlling the attitude of a craft when outside the atmosphere by using jets of gas in lieu of aerodynamic control surfaces.

Reaction Engine—An engine that develops thrust by its reaction to ejection of a substance from it; specifically, such an engine that ejects a jet or stream of gases created by the burning of fuel within the engine.

A reaction engine operates in accordance with Newton's third law of motion, i.e., to every action (force) there is an equal and opposite reaction. Both rocket engines and jet engines are reaction engines.

Readout—1. The action of a radio transmitter transmitting data either instantaneously with the acquisition of the data or by play of a magnetic tape upon which the data have been recorded. 2. In computer operations to extract information from storage.

Readout Station—A recording or receiving radio station at which data are received from a transmitter in a probe, satellite, or other spacecraft.

Real Time—Time in which reporting on events or recording of events is simultaneous with the events.

For example, the real time of a satellite is that time in which it simultaneously reports its environment as it encounters it; the real time of a computer is that time during which it is accepting data.

Recombination—The process by which a positive and a negative ion join to form a neutral molecule or other neutral particle.

Recovery—The procedure or action that obtains when the whole of a satellite, or a satellite instrumentation package, or other part of a rocket vehicle is recovered after a launch; the result of this procedure.

Recycle—In a countdown: To stop the count and to return to an earlier point in the countdown, as in "we have recycled, now at T minus 80 and counting." Compare hold. In testing: to repeat a group or series of tests.

Red Shift—In astronomy, the displacement of observed spectral lines toward the longer wavelengths of the red end of the spectrum. Compare **space reddening.**

The "red shift" in the spectrum of distant galaxies has been interpreted as evidence that the universe is expanding.

Reentry—The event occurring when a spacecraft or other object comes back into the sensible atmosphere after being rocketed to altitudes above the sensible atmosphere; the action involved in this event.

Reentry Vehicle—A space vehicle designed to return with its payload to earth through the sensible atmosphere.

Reentry Window—The area at the limits of the earth's atmosphere through which a spacecraft in a given trajectory can pass to accomplish a successful reentry.

Regenerative Cooling—The cooling of a part of an engine by the propellant being delivered to the combustion chamber; specifically, the cooling of a rocket—engine combustion chamber or nozzle by circulating the fuel or oxidizer, or both, around the part to be cooled.

Regenerator—A device used in a thermodynamic process for capturing and returning to the process heat that would otherwise be lost. Also called "a heat exchanger".

Relative Humidity (abbr rh)—The (dimensionless) ratio of the actual vapor pressure of the air to the saturation vapor pressure.

Relativistic Particles—In general, pertaining to material, as a subatomic particle, moving at speeds which are an appreciable fraction of the speed of light.

Relativity—A principle that postulates the equivalence of the description of the universe, in terms of physical laws, by various observers, or for various frames of reference.

Rendezvous—The event of two or more objects meeting at a preconceived time and place.

A rendezvous would be involved, for example, in servicing or resupplying a space station.

Resonance—1. The phenomenon of amplification of a free wave or oscillation of a system by a forced wave or oscillation of exactly equal period. The forced wave may arise from an impressed force upon the system or from a boundary condition. The growth of the resonant amplitude is characteristically linear in time. 2. Of a system in forced oscillation, the condition which exists when any change, however small, in the frequency of excitation causes a decrease in the response of the system.

Resonance Frequency—A frequency at which resonance exists. Also called "resonant frequency."

In case of possible confusion, the type of resonance must be indicated; as "velocity resonance frequency."

Retrorocket—(From 'retroacting'.) A rocket fitted on or in a spacecraft, satellite, or the like to produce thrust opposed to forward motion.

Revolution—Motion of a celestial body in its orbit; circular motion about an axis usually external to the body.

In some contexts the terms "revolution" and "rotation" are used interchangeably; but with reference to the motions of a celestial body, "revolution" refers to the motion in an orbit or about an axis external to the body, while "rotation" refers to motion about an axis within the body. Thus, the earth revolves about the sun annually and rotates about its axis daily.

Rills—Narrow, sharply-defined features that extend across the surfaces of the lunar MARIA. They may be cracks or wrinkles in the lava beds.

Rocket—1. A projectile, pyrotechnic device, or flying vehicle propelled by a rocket engine. 2. A rocket engine.

Rocket Engine—A reaction engine that contains within itself, or carries along with itself, all the substances necessary for its operation or for the consumption or combustion of its fuel, not requiring intake of any outside substance and hence capable of operation in outer space. Also called **"Rocket Motor."**

Rocket Propellant—Any agent used for consumption or combustion in a rocket and from which the rocket derives its thrust, such as a fuel, oxidizer, additive, catalyst, or any compound or mixture of these. "Rocket propellant" is often shortened to "propellant."

Rocketsonde—Meteorological rocket.

Rockoon—A high-altitude sounding system consisting of a small solid-propellant research rocket launched from a large plastic balloon.

The rocket is fired near the maximum altitude of the balloon flight. It is a relatively mobile rocket-sounding system, and has been used extensively from shipboard.

Roentgen—That amount of x or gamma radiation sufficient to produce ions carrying one electrostatic unit of charge in one cm^3 of air. The term is loosely used to signify that amount of any ionizing radiation which produces the same effect as one roentgen of gamma rays. The average person receives about 0.1 roentgen per year of total body radiation from COSMIC RAYS and the radioactivity of the earth. Five hundred roentgens of full body radiation is fatal to most people.

Roll—The rotational or oscillatory movement of an aircraft or similar body which takes place about a longitudinal axis through the body—called "roll" for any amount of such rotation.

Rotation—Turning of a body about an axis within the body, as the daily rotation of the earth. See **Revolution.**

Rumble—A form of combustion instability, especially in a liquid-propellant rocket engine, characterized by a low-pitched, low-frequency rumbling noise; the noise made in this kind of combustion.

S

Satellite—1. An attendant body that revolves about another body, the primary; especially in the solar system, a secondary body, or moon, that revolves about a planet. 2. A man made object that revolves about a spatial body, such as Explorer I orbiting about the earth.

Scale Height—A measure of the relationship between density and temperature at any point in an atmosphere; the thickness of a homogeneous atmosphere which would give the observed temperature or pressure.

Schlieren—(German, "streaks," "striae.") 1. Regions of different density in a fluid, especially as shown by special apparatus. 2. A method or apparatus for visualizing or photographing regions of varying density in a field of flow.

Screaming—A form of combustion instability, especially in a liquid-propellant rocket engine, of relatively high frequency and characterized by a high-pitched noise.

Scrub—To cancel a scheduled rocket firing, either before or during countdown.

Secondary Cosmic Rays—Secondary emission in the atmosphere stimulated by primary cosmic rays.

Seeing—A blanket term long used by astronomers for the disturbing effects produced by the atmosphere upon the image quality of an observed astronomical body.

Selenocentric—Relating to the center of the moon; referring to the moon as a center.

Selenographic—1. Of or pertaining to the physical geography of the moon. 2. Specifically, referring to positions on the moon measured in latitude from the moon's equator and in longitude from a reference meridian.

Semicircular Canals—Tubes located in the inner ear which play a part in the mechanism of balance and orientation.

Sensible Atmosphere—That part of the atmosphere that offers resistance to a body passing through it. See **Effective Atmosphere.**

Sensor—The component of an instrument that converts an input signal into a quantity which is measured by another part of the instrument. Also called "sensing element."

Service Tower—Gantry Scaffold.

Shadowgraph—A picture or image in which steep density gradients in the flow about a body are made visible, the body itself being presented in silhouette.

Shaker—An electromagnetic device capable of imparting known, and/or controlled vibratory acceleration to a given object.

Shield—Short for "radiation shield"; "heat shield."

Shock Tube—A relatively long tube or pipe in which very brief high-speed gas flows are produced by the sudden release of gas at very high pressure into a low-pressure portion of the tube; the high-speed flow moves into the region of low pressure behind a shock wave.

The shock tube is used as a tool in the study of gases or as a kind of intermittent wind tunnel.

Shock Waves—The phenomena in compressible fluid flow where a positive pressure disturbance propagates and eventually steepens into a shock front. In the limit of a perfect fluid conductor, such variables as velocity, pressure density, temperature, and magnetic field can change discontinuously across a shock front. A high-velocity shock can be driven by passing a large electric current through a highly ionized PLASMA. Highly ionized shocks which propagate through a magnetic field are called MAGNETOHYDRODYNAMIC (MHD) shock waves.

Shoran—(From "short range navigation.") A precision electronic position fixing system using a pulse transmitter and receiver and two transponder beacons at fixed points.

Shot—An act or instance of firing a rocket, especially for the earth's surface, as "the shot carried the rocket 200 miles."

Shroud—The nosecone of a space vehicle when it is used only as a shield for passage through the atmosphere from launch to orbit. It is usually jettisoned when orbital speed is achieved.

Sidereal—Of or pertaining to the stars.

Sloshing—The back-and-forth splashing of a liquid fuel in its tank, creating problems of stability and control in the vehicle.

Slug—A unit of mass; the mass of a free body which if acted upon by a force of 1 pound would experience an acceleration of 1 foot per second per second.

Slurry—A suspension of fine solid particles in a liquid.

Soft Radiation—Radiation which is absorbed by an absorber equivalent to 10 centimeters of lead or less. Radiation which can penetrate more than 10 centimeters of lead is termed "hard radiation."

Solar Atmospheric Tide—Vertical motion of the atmosphere due to thermal or gravitational action of the sun.

Solar Cell—A photovoltaic device that converts sunlight directly into electrical energy.

Solar Constant—The rate at which solar radiation is received on a surface perpendicular to the incident radiation and at the earth's mean distance from the sun, but outside the earth's atmosphere.

Solar Cycle—The observed fluctuation from maximum to minimum of the incidence of SUNSPOTS, and the activity of SOLAR FLARES and prominences, with a mean period of 11.2 years. There is also evidence that the overall magnetic field of the sun fluctuates with the same period.

Solar Flare—Sudden local increase in the intensity of the light of hydrogen on the sun. Some solar flares are associated with the expulsion of charged particles and the production of radio bursts.

Solar Plasma—See **Solar Wind.**

Solar Radiation—The total electromagnetic radiation emitted by the sun.

Solar Wind—A stream of protons constantly moving outward from the sun. Synonymous with solar plasma.

Solid Propellant—Specifically, a rocket propellant in solid form, usually containing both fuel and oxidizer combined or mixed and formed into a monolithic (not powdered or granulated) grain. See **Rocket Propellant** and **Grain.**

Solid-Propellant Rocket Engine—A rocket engine using a solid propellant. Such engines consist essentially of a combustion chamber containing the propellant, and a nozzle for the exahust jet, although they often contain other components, as grids, liners, etc. See **Rocket Engine** and **Solid Propellant.**

Sonic—1. Aerodynamics: Of or pertaining to the speed of sound; that moves at the speed of sound, as in "sonic flow"; designed to operate or perform at the speed of sound, as in "sonic leading edge." 2. Of or pertaining to sound, as in "sonic amplifier".

Sonic Boom—A noise caused by the shock wave that emanates from an aircraft or other object traveling in the atmosphere at or above the speed of sound.

Sonic Speed—The speed of sound; by extension, the speed of a body traveling at Mach 1.

Sound travels at different speeds through different mediums and at different speeds through any given medium under different conditions of temperature, etc. In the standard atmosphere at sea level, sonic speed is approximately 760 miles per hour.

Sounding—1. In geophysics, any penetration of the natural enviroment for scientific observation. 2. In meteorology, same as upper-air observation. However, a common connotation is that of a single complete radiosonde observation.

Sounding Rocket—A rocket designed to explore the atmosphere within 4,000 miles of the earth's surface.

Space—1. Specifically, the part of the universe lying outside the limits of the earth's atmosphere. 2. More generally, the volume in which all spatial bodies, including the earth, move.

Space-Air Vehicle—A vehicle that may be operated either within or above the sensible atmosphere.

Spacecraft—Devices, manned or unmanned, which are designed to be placed into an orbit about the earth or into a trajectory to another celestial body.

Space Equivalent—A condition within the earth's atmosphere that is virtually identical, in terms of a particular function, with a condition in outer space.

For example, at 50,000 feet the low air pressure and the scarcity of oxygen create a condition, so far as respiration is concerned, that is equivalent to a condition in outer space where no appreciable oxygen is present; thus, a physiological space equivalent is present in the atmosphere.

Space Medicine—A branch of aerospace medicine concerned specifically with the health of persons who make, or expect to make, flights into space beyond the sensible atmosphere.

Space Probe—See **Probe.**

Space Reddening—The observed reddening, or absorption of shorter wavelengths, of the light from distant celestial bodies caused by scattering by small particles in interstellar space. Compare **red shift.**

Space Simulator—A device which simulates some condition or conditions existing in space and used for testing equipment, or in training programs.

Space System—A system consisting of launch vehicle(s), spacecraft and ground support equipment.

Space Vehicle—A launch vehicle and its associated spacecraft.

Spatial—Pertaining to space.

Spatio—A combining form meaning "space."

Specific Impulse—A performance parameter of a rocket propellant, expressed in seconds, and equal to thrust (in pounds) divided by weight flow rate (in pounds per second). See **Thrust.**

Spectrometer—An instrument which measures some characteristics such as intensity, of electromagnetic radiation as a function of wavelength or frequency.

Spectrum—1. In physics, any series of energies arranged according to wavelength (or frequency); specifically, the series of images produced when a beam of radiant energy, such as sunlight, is dispersed by a prism or a reflecting grating. 2. Short for "electromagnetic spectrum" or for any part of it used for a specific purpose as the 'radio spectrum' (10 kilocycles to 300,000 megacycles).

Sputtering—Dislocation of surface atoms of a material bombarded by high-energy atomic particles.

Stage—A propulsion unit of a rocket, especially one unit of a multistage rocket, including its own fuel and tanks.

Stage-and-a-Half—A liquid-rocket propulsion unit of which only part falls away from the rocket vehicle during flight, as in the case of booster rockets falling away to leave the sustainer engine to consume remaining fuel.

Standard Atmosphere—1. A hypothetical vertical distribution of atmospheric temperature, pressure, and density which, by agreement, is taken to be representative of the atmosphere for purposes of pressure altimeter calibrations, aircraft performance calculations, aircraft and rocket design, ballistic tables, etc. 2. A standard unit of atmospheric pressure exerted by a 760 mm column of mercury at gravity (980.665 cm/sec^2) at temperature 0°C.

One standard atmosphere = 760 mm Hg
= 29.9213 in. Hg
= 1013.250 mb

Stationary Orbit—An orbit in which an equatorial satellite revolves about the primary at the same angular rate as the primary rotates on its axis. From the primary, the satellite thus appears to be stationary over a point on the primary.

Stefan-Boltzmann Law—One of the radiation laws which states that the amount of energy radiated per unit time from a unit surface area of an ideal black body is proportional to the fourth power of the absolute temperature of the black body.

Stoichiometric—Of a combustible mixture, have the exact proportions required for complete combustion.

Stratosphere—The region of the atmosphere lying on the average between about 12 and 60 kilometers; it has a temperature which is either constant or increases with altitude, and is therefore stable against convection. The upper part of the stratosphere is at a temperature of about 260°K, and is heated by the absorption of ultraviolet light by OZONE.

Subassembly—An assembly within a larger assembly.

Subatomic Particle—A component of an atom, such as an electron, a proton, a meson, etc.

Subsonic—In aerodynamics, dealing with speeds less than the speed of sound (see sonic speed), as in "subsonic aerodynamics."

Subsystem—A functioning entity within a major system (launch vehicle, spacecraft, etc.) of a space system such as propulsion subsystem of a launch vehicle or attitude control subsystem of a spacecraft. Also considered a system.

Sudden Ionospheric Disturbance—(Often abbreviated SID). A complex combination of sudden changes in the condition of the ionosphere, and the effects of these changes.

Sunspot—A relatively dark area on the surface of the sun, consisting of a dark central umbra surrounded by a penumbra which is intermediate in brightness between the umbra and the surrounding photosphere.

Sunspots usually occur in pairs with opposite magnetic polarities. They have a lifetime ranging from a few days to several months. Their occurrence exhibits approximately an eleven year period (the sunspot cycle).

Sunspot Cycle—A cycle with an average length of 11.1 years, but varying between about 7 and 17 years, in the number and area of sunspots, as given by the relative sunspot number. This number rises from a minimum of 0-10 to a maximum of 50-140 about four years later, and then declines more slowly.

An approximate 11-year cycle has been found or suggested in geomagnetism, frequency of aurora, and other ionospheric characteristics.

Eleven-year cycles have been suggested for various tropospheric phenomena, but none of these has been substantiated.

Supersonic—Pertaining to speeds greater than the speed of sound. Compare **ultrasonic.**

Surveyor—The United States program for the scientific exploration of the surface and subsurface of the moon, following the RANGER program. Surveyor A, designed to make SOFT LANDINGS on the moon, will explore the physical, chemical, and mineralogical properties of the moon at the landing site. It is expected to be launched using an ATLAS-Centaur in the last half of 1964. Surveyor B will be placed in a stable orbit about 60 miles above the lunar surface. It will allow a scan by television of the visible and hidden faces of the moon, and will be used for a preliminary selection of APOLLO landing sites, as well as permit studies of radiation near the lunar surface, and the gravity and mass distribution of the moon. The launching of a total of seven Surveyor A's and 5 Surveyor B's is currently planned.

Sustainer Engine—An engine that maintains the velocity of a missile rocket vehicle once it has achieved its programmed velocity by use of booster or other engine.

This term is applied, for example, to the remaining engine of the Atlas after the two booster engines have been jettisoned. The term is also applied to a rocket engine used on an orbital glider to provide the small amount of thrust now and then required to compensate for the drag imparted by air particles in the upper atmosphere.

Sweep—The motion of the visible dot across the face of a cathode-ray tube, as a result of scanning deflection of the electron beam.

Synchronous Rotation—Rotation of a planet or satellite about its axis with the same period as its revolution about a parent body, with the axis of rotation assumed perpendicular to the plane of the orbit. A consequence of this type of rotation is that the planet or satellite always presents the same side or face to the parent body. The moon rotates synchronously with respect to the earth, and Mercury with respect to the sun. There is some evidence that Venus also rotates synchronously with respect to the sun, or at least has a day comparable in length to its year. Synchronous rotation is usually assumed to be caused by TIDAL DRAG acting during the planet's past.

Synchrotron Radiation—Electromagnetic radiation generated by the acceleration of charged relativistic particles (usually electrons) in a magnetic field. Radiation of this kind was first encountered in the particle accelerator called the synchrotron. It is an important mechanism for the generation of nonthermal, continuous radio waves in supernova fragments and galactic halos.

Synchronous Satellite—An equatorial west-to-east satellite orbiting the earth at an altitude of 22,300 statute miles at which altitude it makes one revolution in 24 hours, synchronous with the earth's rotation.

Synergic Curve—A curve plotted for the ascent of a rocket, space-air vehicle, or space vehicle calculated to give the vehicle an optimum economy in fuel with an optimum velocity.

This curve, plotted to minimize air resistance, starts off vertically, but bends towards the horizontal between 20 and 60 miles altitude.

System—1. An organized arrangement in which the operational results of two or more functioning entities can be predicted.

2. Used in term, space system, to mean the launch vehicle, spacecraft and ground support used in a space launch and flight.

3. One of major subdivisions of a space system, such as launch vehicle, spacecraft, or ground support system.

4. One of major functioning entities within a major subdivision of a space system, such as the guidance system of a launch vehicle or the attitude control system of a spacecraft.

In sense 4, synonymous with subsystem.

Systems Intergration—The management process by which the systems of a project (for example, the launch vehicle, the spacecraft, and its supporting ground equipment and operational procedures) are made compatible, in order to achieve the purpose of the project or the given flight mission.

T

Tektite—A small glassy body containing no crystals, probably of meteoritic origin, and bearing no antecedent relation to the geological formation in which it occurs.

Tektites are found in certain large areas called "strewn fields." They are named as minerals with the suffix "ite," as "australite," found in Australia; "billitonite," "indochinite," and "rizalite," found in Southeast Asia; "bediasite" from Texas, and "moldavite" from Bohemia and Moravia.

Telemetry—The science of measuring a quantity or quantities, transmitting the measured value to a distant station, and there interpreting, indicating, or recording the quantities measured.

Terminator—The line separating illuminated and dark portions of a nonluminous body, as the moon.

Terrestrial—Pertaining to the earth.

Thermal Radiation—The electromagnetic radiation emitted by a hot blackbody, such as the filament of a lamp. The distribution of energy with frequency of thermal radiation is given by PLANCK'S LAW. The sun radiates approximately as a blackbody with a temperature of about 5700°K. (See NONTHERMAL RADIATION.)

Thermocouple—A temperature-sensing element which converts thermal energy directly into electrical energy. In its basic form it consists of two dissimilar metallic electrical conductors connected in a closed loop. Each junction forms a thermocouple.

If one thermocouple is maintained at a temperature different from that of the other, an electrical current proportional to this temperature difference will flow in the circuit; the value of this proportionality varies with materials used. For meteorological purposes, couples of copper and constantan are frequently used which generate approximately 40 microvolts per °C of couple temperature difference.

Thermodynamic—Pertaining to the flow of heat or to thermodynamics.

Thermodynamics—The study of the relationships between heat and mechanical energy.

Thermonuclear—Pertaining to a nuclear reaction that is triggered by particles of high thermal energy.

Thermosphere—The region of the atmosphere, above the MESOSPHERE, in which there is strong heating and increasing temperature, resulting from the PHOTODISSOCIATION of O_2 and the PHOTOIONIZATION of N, N_2 and O. It extends roughly from an altitude of 90 to 600 kilometers.

Thrust—1. The pushing force developed by an aircraft engine or a rocket engine. 2. Specifically, in rocketry, the product of propellant mass flow rate and exhaust velocity relative to the vehicle.

Thrust-to-Weight Ratio—The ratio of the engine THRUST of a rocket to the total vehicle weight. This ratio must be greater than one to lift the vehicle off the ground.

Tidal Drag—The damping of a planet or satellite's rotation produced by frictional losses associated with tides raised either in the solid body of the planet or satellite, or in seas upon its surface. (See SYNCHRONOUS ROTATION.)

Tiros—A series of United States meteorological satellites designed to observe the cloud coverage of the earth and measure the heat radiation emitted by the earth in the infrared.

Topside Sounder—A satellite designed to measure ion concentration in the ionosphere from above the ionosphere.

Tore or Torus—In geometry the surface described by a conic section, especially a circle, rotating about a straight line in its own plane or the solid of revolution enclosed by such a surface. Hence, the extended sections of a manned space laboratory, having a generally circular configuration and rotating around a stationary central section.

Torr. (From Torricelli)—Suggested international standard term to replace the English term "millimeter of mercury" and its abbreviation "mm of Hg" (or the French "mm de Hg").

Both "Tor" and "Torr" have been used in Germany, the latter spelling being more common and the one officially adopted by the German Standards Association. The "Torr" is defined as 1/760 of a standard atmosphere or 1,013,250/760 dynes per square centimeter. This is equivalent to defining the "Torr" as 1333.22 microbars and differs by only one part in seven million from the International Standard millimeter of mercury. It is recommended that "Torr" not be abbreviated. However, the abbreviation τ has been used. The prefixes "milli" and "micro" are attached without hyphenation.

Tracking—The process of following the movement of a satellite or rocket by radar, radio, and photographic observations.

Trajectory—In general, the path traced by any body, as a rocket, moving as a result of externally applied forces.

Trajectory is loosely used to mean "flight path" or "orbit."

Transducer—A device capable of being actuated by energy from one or more transmission systems or media, as a microphone, a thermocouple, etc.

Transfer Orbit—In interplanetary travel an elliptical trajectory tangent to the orbits of both the departure planet and the target planet.

Transit—1. The passage of a celestial body across a celestial meridian; usually called "meridian transit." 2. The apparent passage of a celestial body across the face of another celestial body or across any point, area, or line.

Translunar—Of or pertaining to space outside the moon's orbit about the earth.

Transponder—A combined receiver and transmitter whose function is to transmit signals automatically when triggered by an interrogating signal.

Transponder Beacon—A beacon having a transponder.

T-Time—Any specific time, minus or plus, as referenced to "zero," or "launch" time, during a countdown sequence that is intended to result in the firing of a rocket propulsion unit that launches a rocket vehicle or missile.

Troposphere—That portion of the atmosphere from the earth's surface to the tropopause; that is, the lowest 10 to 20 km of the atmosphere. The troposphere is characterized by decreasing temperature with height, appreciable vertical wind motion, appreciable water vapor content, and weather. Dynamically, the troposphere can be divided into the following layers: surface boundary layer, Ekman layer, and free atmosphere.

U

Ullage—The amount that a container, such as a fuel tank, lacks of being full.

Ultrasonic—Of or pertaining to frequencies above those that affect the human ear, i.e., more than 20,000 vibrations per second.

The term "ultrasonic" may be used as a modifier to indicate a device or system intended to operate at an ultrasonic frequency.

Although "supersonic" was formerly used in acoustics synonymously with "ultrasonic," this usage is now rare.

Ultraviolet Radiation—Electromagnetic radiation shorter in wavelength than visible radiation but longer than X-rays; roughly, radiation in the wavelength interval between 10 and 4000 angstroms.

Ultraviolet radiation from the sun is responsible for many complex photochemical reactions characteristic of the upper atmosphere, e.g., the formation of the ozone layer through ultraviolet dissociation of oxygen molecules followed by recombination to form ozone.

Umbilical Cord—Any of the servicing electrical or fluid lines between the ground or a tower and an upright rocket missile or vehicle before the launch. Often shortened to 'umbilical'.

Upper-Air Observation—A measurement of atmospheric conditions aloft, above the effective range of a surface weather observation. Also called "sounding," "upper-air sounding."

V

Van Allen Belt, Van Allen Radiation Belt—[For James A. Van Allen, 1915-.] The zone of high-intensity radiation surrounding the earth beginning at altitudes of approximately 1000 kilometers.

The radiation of the Van Allen belt is composed of protons and electrons temporarily trapped in the earth's magnetic field. The intensity of radiation varies with the distance from the earth, thus the Van Allen belt is often considered as two belts or zones, with maxima of intensity at approximately 3600 kilometers and 16,000 kilometers.

Vehicle—Specifically, a structure, machine, or device, such as an aircraft or rocket, designed to carry a burden through air or space; more restrictively, a rocket craft.

This word has acquired its specific meaning owing to the need for a term to embrace all flying craft, including aircraft and rockets.

Vehicle Control System—A system, incorporating control surfaces or other devices, which adjusts and maintains the altitude and heading, and sometimes speed, of the vehicle in accordance with signals received from a guidance system.

The essential difference between a control system and a guidance system is that the control system points the vehicle and the guidance system gives the commands which tell the control system where to point. However, the control system maintains the instantaneous orientation of the vehicle without specific commands from the guidance system.

Vernier Engine—A rocket engine of small thrust used primarily to obtain a fine adjustment in the velocity and trajectory of a ballistic missile or space vehicle just after the thrust cutoff of the last propulsion engine, and used secondarily to add thrust to a booster or sustainer engine. Also called 'vernier rocket'.

Vertical—The direction in which the force of gravity acts.

Visible Radiation—Electromagnetic radiation lying within the wavelength interval to which the human eye is sensitive, which is from approximately 0.4 to 0.7 micron (4000 to 7000 angstroms). This portion of the electromagnetic spectrum is bounded on the shortwavelength end by ultraviolet radiation, and on the longwavelength end by infrared radiation.

Voyager—A series of spacecraft which will be launched by the United States as a successor to the MARINER program. Voyager craft, launched using the Saturn, will be directed into stable orbits around Mars and Venus, and will attempt to SOFT-LAND instrumented payloads on both these planets. Others may be used for flyby studies of Mercury and Jupiter.

W

Waveguide—A system of material boundaries capable of guiding electromagnetic waves.

Weight—The force with which an earth-bound body is attracted toward the earth.

Weightlessness—A condition in which no acceleration, whether of gravity or other force, can be detected by an observer within the system in question.

Any object falling freely in a vacuum is weightless, thus an unaccelerated satellite orbiting the earth is "weightless" although gravity affects its orbit. Weightlessness can be produced within the atmosphere in aircraft flying a parabolic flight path.

Waiver—Granted use or acceptance of an article which does not meet specified requirements.

Whistler—A radio-frequency electromagnetic signal sometimes generated by lightning discharges.

This signal apparently propagates along a geomagnetic line of force, and often "bounces" several times between the Northern and Southern Hemispheres. Its name derives from the sound heard on radio receivers.

X

X-Ray—Electromagnetic radiation of very short wavelength, lying within the wavelength interval of 0.1 to 100 angstroms (between gamma rays and ultraviolet radiation', 'Roentgen ray).

X-rays penetrate various thickness of all solids and they act upon photographic plates in the same manner as light. Secondary X-rays are produced whenever X-rays are absorbed by a substance, in the case of absorption by a gas, this results in ionization.

Y

Yaw—1. The lateral rotational or oscillatory movement of an aircraft, rocket, or the like about a transverse axis. 2. The amount of this movement, i.e., the angle of yaw.

Year of the Quiet Sun—Eleven year low period in solar activity which is expected between April, 1964 and December, 1965. The international program for maximum observation and research in this interval is termed International Year of the Quiet Sun (IQSY).

Z

Zenith—That point of the celestial sphere vertically overhead. The point 180° from the zenith is called the "nadir."

Zero G = Weightlessness.

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